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ABSTRACT

This book contains a unit on science and global education that is designed to enable students to gain a practical understanding of the world they live in and the confidence to take appropriate action as responsible global citizens. This unit emphasizes cooperative learning that is experiential and participatory. Teachers and students are encouraged to explore the interconnections between global concerns such as food supply, biodiversity, resource use and distribution, water, and energy. Some of the activities explore connections between traditionally defined subject areas. The activities serve as models of how to integrate global education into the science program. The unit is divided into four sections: (1) Water and the Environment; (2) Living Things and Biodiversity; (3) Energy and Resources; and (4) Food Supplies. Each section contains activities and suggestions for further study along with background information on the theme. Because these themes reemerge over the three junior high school years, the activities can be used with increasing sophistication depending upon the grade level and characteristics of the students with whom they are being explored. For each activity or group of activities, there is also a statement about the curricular fit with the Alberta Program of Studies in Canada. (JRH)

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Going Global:

Science Issues for the Junior High

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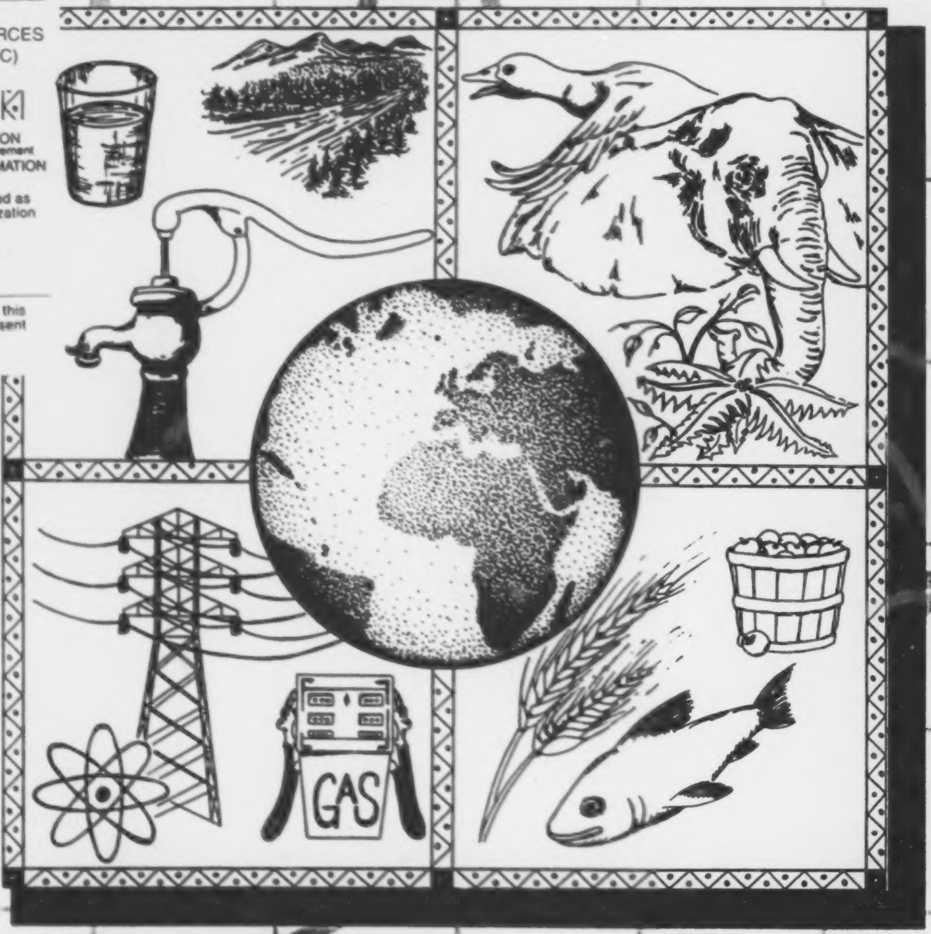

World Citizens Centre and
Alberta Global Education Project

by Louella Cronkhite, Liz Arthur, Lise Schmidt and Wayne Youngward

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Acknowledgements

This teaching unit represents the joint efforts of the Alberta Global Education Project, the World Citizens Centre in Lethbridge, and teachers from Lethbridge Public School District #51, Lethbridge Catholic Separate School District #9, and the County of Lethbridge.

The Alberta Global Education Project is funded by the Canadian International Development Agency, the Alberta Teachers' Association and Alberta Education.

Authors of the unit are:

Liz Arthur
Gilbert Paterson Junior High School
Lethbridge School District #51
Lethbridge, AB

Lise Schmidt
St. Francis Junior High School
Lethbridge Separate School District
Lethbridge, AB

Louella Cronkhite
Project Coordinator
World Citizens Centre
Lethbridge, AB

Wayne Youngward
Coalhurst High School
County of Lethbridge
Coalhurst, AB

Thanks as well to Ron Moline, of Winston Churchill High School, for his contributions to the planning of the unit and the accompanying workshop.

Copies of this teaching unit and of other materials for use in the classroom are available from the Alberta Global Education Project, 11010 - 142 Street, Edmonton, AB T5N 2R1.

November 1995

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A Global Education Approach to Science at the Junior High Level

The program rationale and philosophy statement of the Junior High Program of Studies for Science begins by stating, "The aim of education is to develop the knowledge, the skills and the positive attitudes of individuals, so that they will be self-confident, capable and committed to setting goals, making informed choices and acting in ways that will improve their own lives and the life of their community."

The statement continues by asserting that science education contributes to this overall aim of education in several ways:

- first, by providing learning experiences that help students understand and interpret the world in which they live
- second, by developing knowledge, skills and attitudes that support the intelligent and responsible application of science and technology
- third, by developing a foundation of knowledge, skills and attitudes that support further study of the sciences.

Science education in Alberta is seen as a means of preparing students to understand the development and application of science and scientific knowledge to the world around us, and to examine the implications of science and technology with respect to personal and social impacts.

We live in a world where every year, about 30,000 seals die of strangulation because of plastic bags and fishing nets lost at sea; where, in downtown Mexico City, one of the most polluted cities in the world, people who need a breath of fresh air can visit their local oxygen bar. For a few pesos, they can breathe pure oxygen for several seconds; where, although there are approximately 32 times as many inhabitants of India as Canada, we Canadians contribute about 10 times as much to the deterioration of the Earth's life support systems as do Indians.

Science teaching as we near the turn of the century should reflect the decisive changes needed to alter current world trends. The inclusion of the relationship of science and technology to society in the Alberta Program of Studies is an important move in this direction. And the inclusion of a **global education** focus will assist students to understand the implications of science and technology, not just in their own backyards, but in the world as a whole. Science should enable students to gain the scientific and technical knowledge needed to fulfil civic responsibilities in an increasingly technological society.

To combine the study of significant global problems and science will require new approaches to teaching and learning, approaches consistent with a global education approach. The science and global education classroom is committed to cooperative learning that is experiential and participatory; it is a place where students gather information to form a knowledge base that will equip them to appreciate themselves and others, understand and accept alternative points of view and feel confident to take appropriate action to effect positive change in both their immediate and global environments.

Teachers and students are encouraged to explore the interconnections between global concerns such as food supply, biodiversity, resource use and distribution, water and energy.

Some of the activities in this unit also explore connections between the traditionally defined subject areas, so that an activity may include ideas and teaching strategies more commonly found in social studies or math or domestic science.

The activities in the unit serve as models of how to integrate global education into the science program. With practise, the themes and topics of global education can be incorporated almost everywhere in the science curriculum.

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Format of the Unit

This unit is divided into four sections, according to four of the major themes of the Program of Studies. They are:

Water and the Environment
Living Things and Biodiversity
Energy and Resources
Food Supplies

Each section contains activities and suggestions for further study, along with background information on the theme. Because these themes re-emerge over the three junior high years, the activities can be used with increasing sophistication, depending on the grade level and characteristics of the students with whom they are being explored. For each activity or group of activities, there is also a statement about the curricular fit with the Alberta Program of Studies.

We encourage you to use, modify and expand these activities according to your students' needs and interests. It is our hope that the students will gain a practical understanding of the world they live in and the confidence to take the appropriate actions of responsible global citizens.

CIDA Photo: David Barbour, Tanzania

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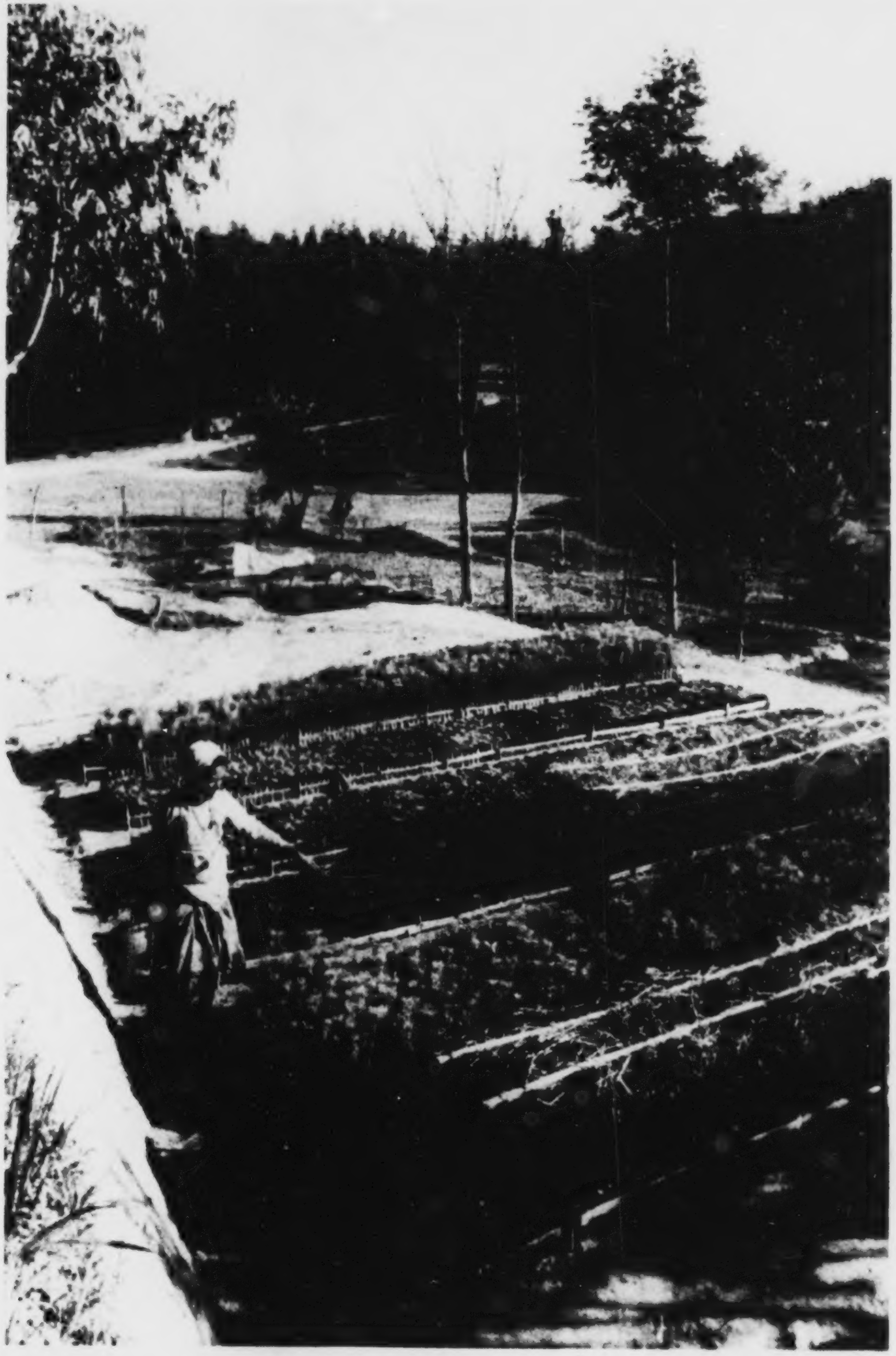
CIDA Photo: David Barbour, Ethiopia

Unit 1

Water and the Environment



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THEME: WATER

Alberta Program of Studies Curriculum Fit

Grade 8, Topic 1: **Solutions and Substances**

SPECIFIC LEARNER EXPECTATIONS

Attitudes

Students will be encouraged to develop:

- Appreciation of the extent to which solutions are a part of living things, natural products and manufactured products.
- Awareness of solution chemistry as a practical science

Skills

- Proposing ideas
  - hypothesizing relationships between variables
  - predicting based on extrapolation of trends

- Designing Experiments
  - identifying and controlling variables
  - developing experimental procedures

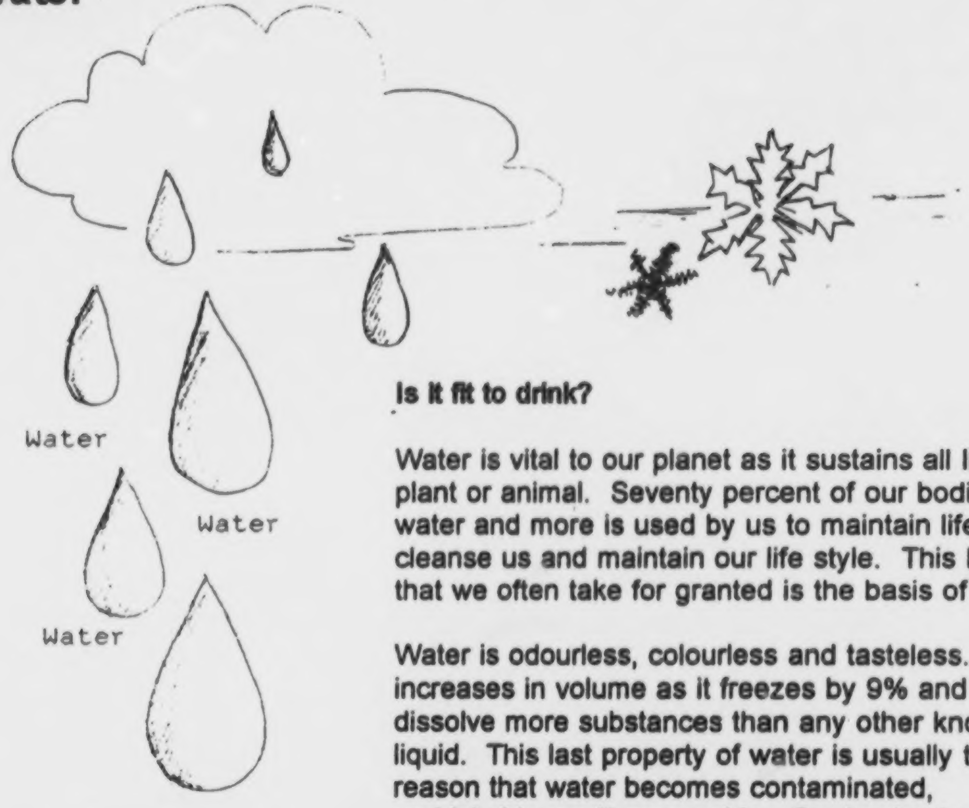
- Gathering Data
  - observing
  - measuring solubility of materials

- Interpreting Data
  - inferring the solubility of different materials

Concepts

- Solutions can be found in many forms, both in natural and human-made materials.
- Knowledge of solubility can be applied to the separation of materials.
  Students will be expected to:
  - identify procedures that can be used for the separation of mixtures into their components, and describe the principles on which they are based (eg., settling, filtration, evaporation distillation, crystallization)
  - apply techniques of filtration
  - describe and carry out specific techniques for recovery of solutes from aqueous solutions
  - identify and describe examples of the separation of solutes

Water



Is it fit to drink?

Water is vital to our planet as it sustains all life - plant or animal. Seventy percent of our bodies is water and more is used by us to maintain life, cleanse us and maintain our life style. This liquid that we often take for granted is the basis of all life.

Water is odourless, colourless and tasteless. It increases in volume as it freezes by 9% and can dissolve more substances than any other known liquid. This last property of water is usually the reason that water becomes contaminated, undrinkable, and/or unusable. Contamination can occur from animal and human waste, manufacturing, agriculture, soil runoff, leaching of chemicals in the ground and through careless washing practises.

In developing countries, rivers and lakes are used for hygiene, drinking water (human and animal), irrigation, and transportation. As a result, water is more often a carrier of disease and pollution than a thirst quencher. Obtaining water from deep wells still poses the problems of seepage and keeping it properly stored and clean when it is brought to the surface.

Background Information

- Of all life-sustaining elements, water is the most essential.
- Only Earth, of all the planets, has water for the support of life as we know it.
- A person can survive approximately one week without water.
- Water covers about three-quarters of the earth's surface, but 97.4% is salt water. 1.8% is frozen.
- Fresh water constitutes only 0.8% of the total water supply.
- The percent of fresh water that is still uncontaminated is unknown.

Water is a Finite Resource.

- About one quarter of the world's population drinks contaminated water.
- Water related diseases claim perhaps 40 million lives per year.
- Safe drinking water and sanitary facilities for all would reduce world infant mortality by 50 percent.
- Approximately 80% of all sickness and disease can be attributed to inadequate water or sanitation.
- Water-related diseases include schistosomiasis, polio, typhoid, leprosy, roundworm, sleeping sickness, malaria, river blindness, dysentery.

Every living thing consists mostly of water.

What do you, an elephant, and an ear of corn have in common? Read on!

*A mouse - 65%
*A chicken - 75%
*An elephant - 70%
*An earthworm - 80%
*Human body - 70%
*Milk - 85%
*Bread - 30%
*Steak - 60%
*Watermelon - 92%
*Pineapple - 80%
*Tomato - 95%
*Carrots - 90%
*Cucumbers - 95%
*Corn on the cob - 70%

It takes a lot of water to make things, too.

A great deal of water is required to produce and process all of the materials that go into the manufacturing of goods.

*One Sunday newspaper - about 600 litres
*One automobile tire - about 8,000 litres
*One slice of bread - 150 litres
*One tonne of paper - 250 tonnes of water
*One tonne of steel - 150 tonnes of water
*One tonne of grain - 1,000 tonnes of water

Water is important for life

- Water provides a home for nearly 90% of all growing plants.
- A person can live without food for more than a month - but can live only a week without water.
- A person must take in 2.5 litres of water a day to maintain a normal water balance in the body.
- A person will drink about 64,000 litres of water in a lifetime.

	Normal Use	Conservation Use
Shower	Water running: 100 litres	Wet down, soap up, rinse off 16 litres
Brushing Teeth	Tap running: 40 litres	Wet brush, rinse briefly 2 litres or less
Tub Bath	Full: 144 litres	Minimal water level: 40 - 60 litres
Toilet Flushing	Depending on tank size: 20 to 28 litres	Using tank displacement bottles: 16 to 24 litres
Dishwashing	Tap running: 120 litres	Wash and rinse in dishpans or sink: 20 litres
Automatic Dishwasher	Full cycle: 64 litres	Short cycle: 28 litres
Shaving	Tap running: 80 litres	Fill basin: 4 litres
Washing Hands	Tap running: 8 litres	Fill basin: 4 litres
Washing Machine	Full cycle, top water level: 240 litres	Short cycle, minimal water level: 108 litres
Outdoor Watering	Average hose: 40 litres per minute	Lowest priority - Use little or none

Source: *Alternatives* Newsletter, Vol. 8, No. 3, 1982

Activity One: Can You Make It Safe?

Problem: How can some pollutants be removed from water samples?

Materials:
samples of water from local streams, lakes or rivers
prepared samples of water contaminated with soil, humus, salt or soap
funnels, tin cans, screen mesh, cotton cloth, linen
bowls or plastic buckets
gravel and sand
any other materials that you or the students may want to use that might be available in a developing nation.

Procedure: You are a villager with polluted river water and only a few resources to clean it. Your task is to design a filtering mechanism that will clean the water the best with the limited resources.

Observations:

Characteristics of sample before filtering:

1.

2.

Characteristics of sample after filtering:

Diagram of filtering mechanism (all parts labelled)

Conclusion:

How successful was your method of filtering? Did it remove all the pollutants? Was there any evidence that the water was drinkable or would more have to be done to make the water fit to drink?

Application:

Could one of these methods help in cleaning the water: chemical treatment, distillation or boiling the water before use?

CIDA Photo: David Barbour, Sudan

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Background Information for Activities Two-Four

Water and Health in the Southern Nations

An adequate, safe supply of water is a basic human right, yet:

- Worldwide, 1.3 billion people (26%) lack safe drinking water and 1.7 billion (34%) lack water for sanitation.
- 80% of the rural populations of 73 African and Asian countries, whose populations are mostly rural, do not have access to safe drinking water.
- 25% of the world's people lack safe drinking water and sanitation. Water-borne diseases kill at least 25 million people in developing nations. each year. An inadequate water supply is implicated in trachoma blindness (500 million sufferers), schistosomiasis (250 million), and elephantiasis (250 million).
- Diarrheal diseases resulting from impure water affect 500 million people each year and are the largest killer of children under 2 years old.

However, significant progress has been made:

- The proportion of rural people without access to safe drinking water decreased by 25 % between the 1960s and 1980s. (However, the scale of rural to urban migration has prevented any increase in the percentage (approximately 70%) of the urban population that has a safe water supply.)
- Between 1973 and 1978, 270 million people gained access to a safe water supply and 180 million obtained adequate sewage treatment.
- Governments of poor countries and donor nations spend about (US) $1500 million each year on rural water supply.
- The annual expenditure of $20 billion necessary to provide all people on Earth with safe drinking water and adequate sewage treatment by 1990 represents about 4% of annual global military expenditure.

Source: "Water 2020: Sustainable Use for Water in the 21st Century", **Science Council of Canada** Report 40, June 1988, p. 20.

This resource is available free of charge from The Publications Office, Science Council of Canada, 100 Metcalfe Street, Ottawa, Ontario, K1P 5M1

Native Communities in Canada

Lest we think that conditions are bad only somewhere else:

The standards of water supply and sanitation on the Native reserves in some parts of Canada are much lower than in many developing countries,

- There are an estimated 330,000 native Canadians; approximately 70%, or more than 220,000, lived on reserves in 1984.

- The majority of reserves in northern Alberta lack proper water supply and sewage disposal facilities. In Saskatchewan and Manitoba, where native people represent between 4 and 5 percent of the population, fewer than 15 per cent of the on-reserve houses had running water in 1977 and fewer than 10 percent of the houses had sewers or septic tanks.

- Only 50 percent of the on-reserve houses for native people across Canada have running water; more than 100,000 native Canadians live in houses without running water.

Source: "Water 2020: Sustainable Use for Water in the 21st Century", **Science Council of Canada** Report 40, June 1988, p. 11

Activity Two: Storing the Water

Note: The following article on water is taken from ***Under the Same Sun*****: Water** and is found on pages 12 and 13 of the magazine.

Procedure: Have students read the following article and answer these questions.

1. Drinking water in many countries is often far from home and must be carried by hand in whatever containers are available. Describe four characteristics of a good water container (eg., has a cover).

2. The water must be stored until it can be used. What are some of the problems encountered in storing water?

   What additional problems might there be if the containers are metal?

3. The article states that people need at least 4 to 6 litres of water a day to survive. Including water for personal hygiene and laundry, we should figure from 20 to 30 litres per day per person. The average young Canadian uses over 200 litres of water per day.

   Why do Canadians use so much water?

   Even though we have a great deal of fresh water in Canada, why should we conserve the amount of water we use in the home?

   Find a container that holds 20 to 30 litres. Try to carry it when it is full of water.
   How much does it weigh?
   How would your use of water change if you had to carry 200 litres of water per day?

4. List at least four ways you could conserve water in your home. Ask your family members if you can't think of four ways. Choose one of these ideas and start a new habit. For example, if you run the water while you brush your teeth, try filling a glass with water and using it to rinse your mouth.

5. As a class, make a booklet of all the ideas that your classmates have for saving water. If your school has a newsletter, why not ask if you can publish some of these ideas?

Tell me...

Which water-related diseases affect the most people in developing nations?

Various kinds of diseases are associated with water. Some are caused from drinking polluted water. One of these is diarrhea, which affects the most people, especially children. Diarrhea is a serious illness in developing countries. It can quickly lead to dehydration and, if untreated, it can cause death.

Some diseases spread in water. Bilharziasis is one example. This disease is caused by small worms that develop in snails. The larvae leave the snail and spread through the water. People are infected when the parasite enters the body through the skin. This can happen at any time, while washing or wading into the water to do laundry.

Other diseases, like malaria, are caused by insect bites. Malaria is spread by mosquitoes, which look like our sand flies. They multiply in wet areas or during the rainy season.

Is acid rain a problem in developing countries?

Today, acid rain is a more critical problem in industrialized countries. Sulphur and nitrogen oxides cause acid rain. In North America, thermal power stations and non-ferrous metal foundries are the main sources of sulphur oxide. Cars and other vehicles are the chief sources of nitrogen oxide. But some developing countries are quickly becoming industrialized and will soon face the serious problem of acid rain themselves.

There is a reason to fear that one day acid rain may become a global problem. We must always remember that nothing escapes the environment: we cannot heedlessly tamper with an ecological system in one region of the world without jeopardizing the ecological balance of the entire planet.

Is rain water good to drink?

That depends on where in the world you live. When air pollution is not too bad, rainwater is good to drink. But water is often polluted when it is collected, transported or stored.

Water is easily polluted: all it takes is a dirty container.

Are there different kinds of wells?

A well can be dug by hand or mechanically with a well-sinker. The diameter of hand-made wells must be large enough to allow the well-builder to get in and work. Hand-made wells are usually no more than 5 to 20 m deep.

A well can be drilled by sinking a long tube into the ground with a device called an auger or trepan.

A drilled well may be 50 or more metres deep, depending on the kind of drilling equipment used.

When we cover a well, how can we be sure the water is clean?

It is easier to keep well water clean when the well is covered, and especially when it has a pump. This eliminates pollution from the surface, such as animal dung or polluted mud around the well. It also eliminates pollution from dirty containers that have to be dipped into the clean well water if there is no pump. But water can still be polluted during transportation and storage.

What happens when a well runs dry?

We dig deeper to reach another underground water supply. This job can be done by hand or mechanically.

Why doesn't underground water always come to the surface?

Because of the earth's gravity. Water seeps deep into the earth until it reaches a barrier it cannot penetrate. Here it forms an underground water supply known as the water table. This is the water that refills wells and is brought to the surface with a pump.

Why must women in rural areas walk so many kilometres to reach a water supply?

First of all, the village well may have run dry, or its water has been polluted. As well, governments are responsible for deciding where to locate the wells. Usually, a fairly central site is selected so that people from several villages have access to drinking water. And of course, the well is dug where water can be found.

How many people can a well supply with water?

That depends on the well's output. An average well can supply 18,000 litres of water a day. People need at least 4 to 6 litres a day to survive. When we include water for personal hygiene and laundry, we must figure from 20 to 30 litres per day per person. A well with a pump can therefore serve the needs of about 500 people. Remember that on average, each young Canadian uses over 200 litres of water each day.

What can we do to ensure that people in developing countries have a water supply?

Become aware that water-related problems don't just happen in developing countries.

Become a citizen who is informed about world realities.

Believe in our ability to take action and cooperate.

Join an organization that works to solve water problems in developing nations.

Change our attitudes, behaviour and expectations in order to find a lifestyle that is in greater harmony with the rest of the planet.

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Activity Three: Tropical Trade Off Game

(from *Under the Same Sun: Health*, c. 1988, pages 12-13

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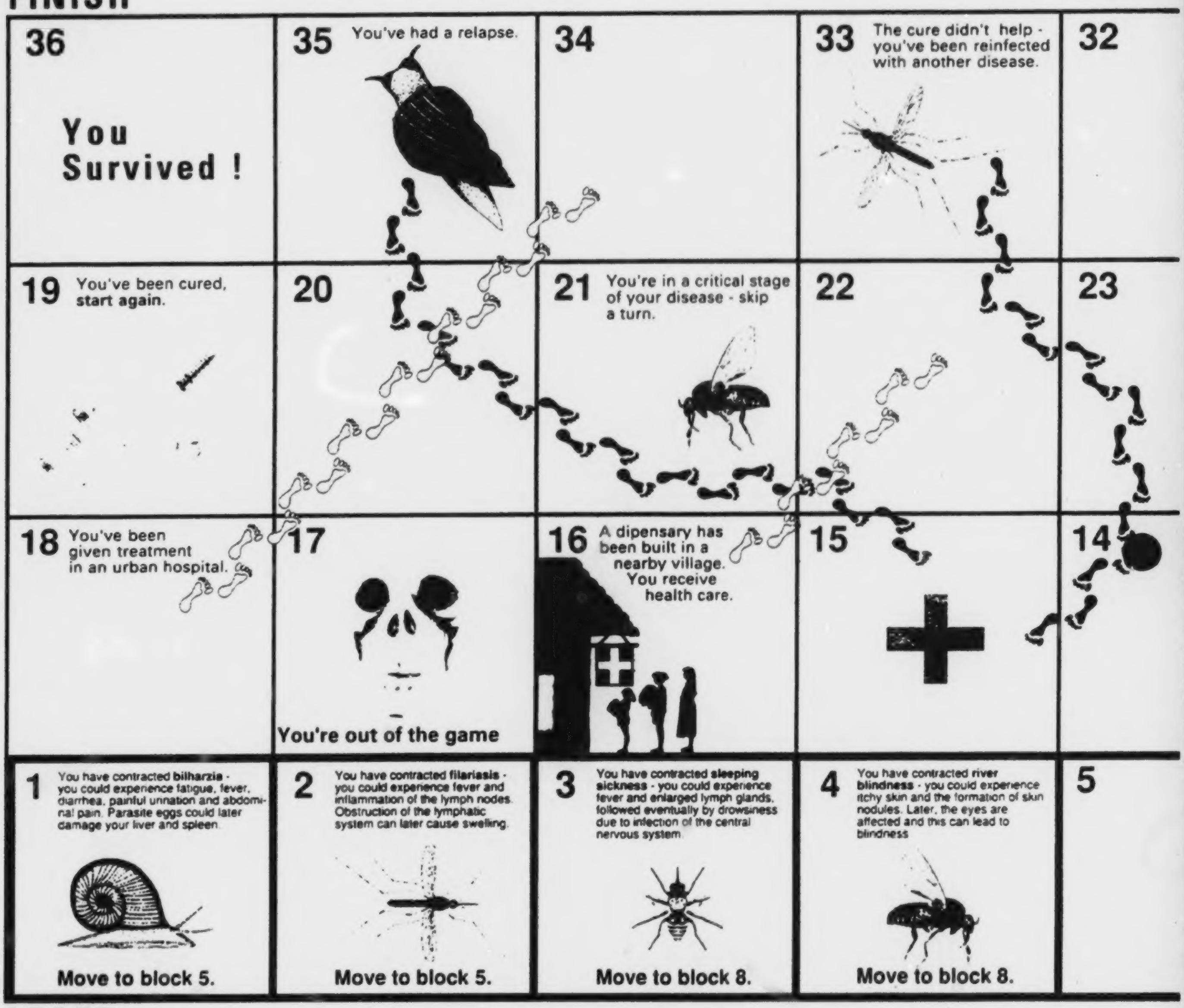

36 **You Survived !**

35 You've had a relapse.

34

33 The cure didn't help - you've been reinfected with another disease.

32

19 You've been cured, **start again.**

20

21 You're in a critical stage of your disease - skip a turn.

22

23

18 You've been given treatment in an urban hospital.

17 **You're out of the game**

16 A dipensary has been built in a nearby village. You receive health care.

15

14

1 You have contracted **bilharzia** - you could experience fatigue, fever, diarrhea, painful urination and abdominal pain. Parasite eggs could later damage your liver and spleen. **Move to block 5.**

2 You have contracted **filariasis** - you could experience fever and inflammation of the lymph nodes. Obstruction of the lymphatic system can later cause swelling. **Move to block 5.**

3 You have contracted **sleeping sickness** - you could experience fever and enlarged lymph glands, followed eventually by drowsiness due to infection of the central nervous system. **Move to block 8.**

4 You have contracted **river blindness** - you could experience itchy skin and the formation of skin nodules. Later, the eyes are affected and this can lead to blindness. **Move to block 8.**

5

START

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Today, besides diarrhea, the main killers are measles, tetanus, whooping cough, diphtheria, poliomyelitis and tuberculosis. These illnesses claim at least four million children a year, due mainly to increased vulnerability caused by malnutrition. A further 4.5 million are disfigured or disabled as a result of disease.

We will assume that all participants have somehow survived or been immunized against these diseases. But nobody's safe yet.

Let's assume that you live in tropical Africa. This means that you are also exposed to all kinds of other diseases. We will only include the major ones: bilharzia, sleeping sickness, leishmaniasis, river blindness, filariasis and malaria.

These diseases are transmitted by the bites of insects (except bilharzia) making insects the vectors of the diseases. In the case of bilharzia, the vector is a snail.

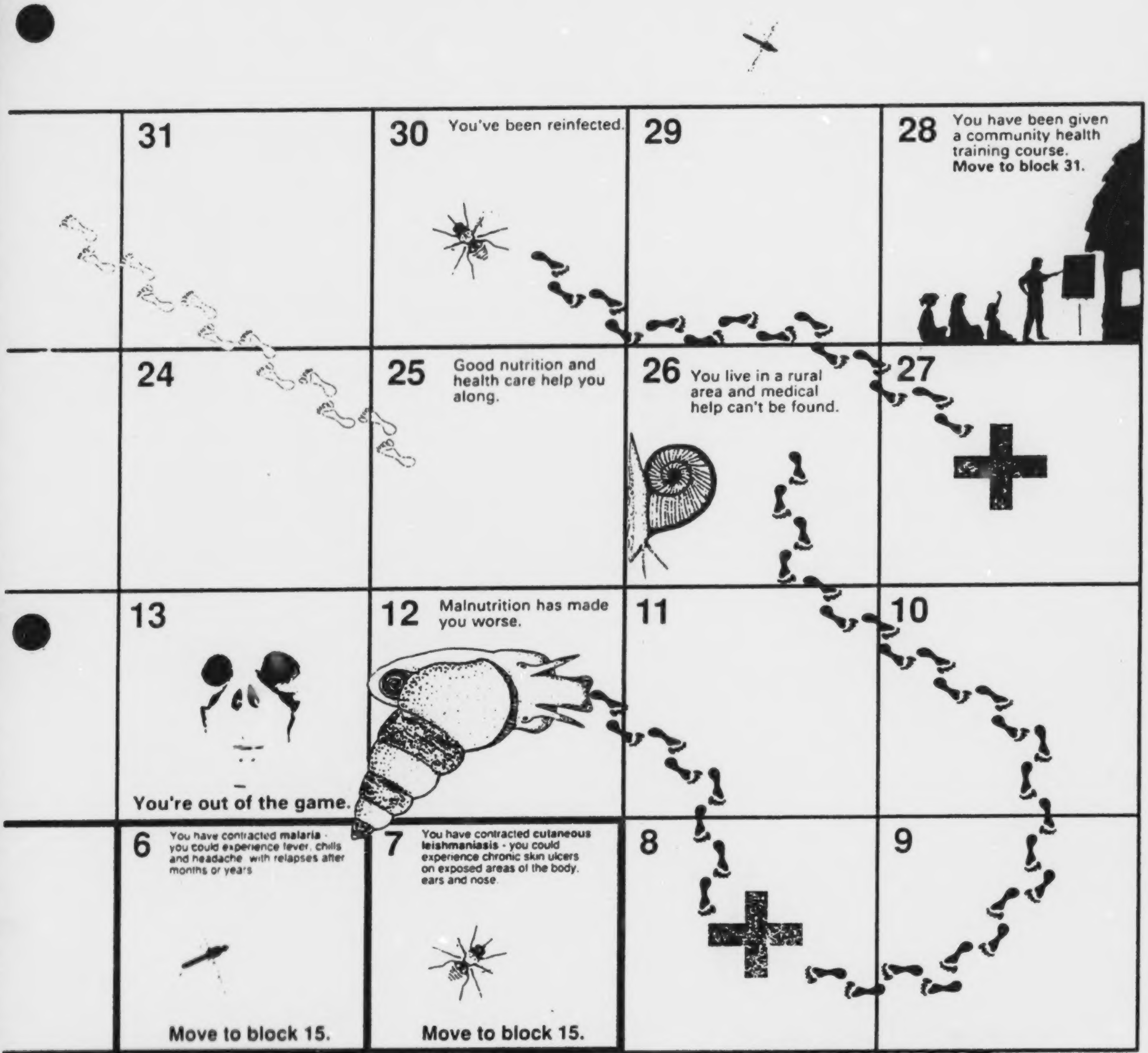
Objective of the Game

This exercise is to make you aware that disease in developing countries is almost impossible to avoid, and that proper treatment is most likely impossible to obtain.

How to Play

You will need:
- 2 to 6 players
- a dice
- markers or tokens for each player

Playing is simple. The rules are the same as for Snakes and Ladders. However, surviving is the tough part.



	31	30 You've been reinfected.	29	28 You have been given a community health training course. **Move to block 31.**
	24	25 Good nutrition and health care help you along.	26 You live in a rural area and medical help can't be found.	27
	13 **You're out of the game.**	12 Malnutrition has made you worse.	11	10
	6 You have contracted **malaria** - you could experience fever, chills and headache, with relapses after months or years **Move to block 15.**	7 You have contracted **cutaneous leishmaniasis** - you could experience chronic skin ulcers on exposed areas of the body, ears and nose. **Move to block 15.**	8	9

Bilharzia (schistosomiasis) is a water-borne parasitic disease contracted by roughly 10% of the population in developing countries. Children 5 to 19 years of age have the highest rate of infection. The disease is caused by a tiny parasitic flatworm, which lives part of its life cycle in freshwater snails. It infects man during its larval stage when it burrows into the skin and enters the blood stream. It eventually matures in the veins of the bladder or bowels and can reach 1 to 2 cm.

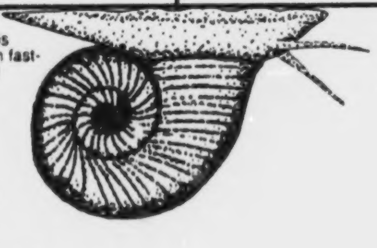
ilariasis is a disease caused by parasitic infestation. It ransmitted by night-biting mosquitos. It is endemic* to pical Africa, Asia and the Pacific Islands.

African sleeping sickness is a parasitic disease transmitted by the tsetse fly. It is endemic* to tropical Africa.

River blindness is caused by a parasitic worm. It is transmitted by the bite of a black fly, which breeds in fast-flowing streams. It is endemic* to tropical Africa and Central America.

Malaria, meaning "bad air", is caused by a blood parasite which is transmitted by the Anopheles mosquito. It occurs in tropical countries.

Cutaneous leishmaniasis is a parasitic disease transmitted by the sandfly. It is endemic* to tropical Africa, Asia, and South America.



We would like to thank the direction of Pugwash Magazine who graciously gave us permission to reproduce and adapt this game.

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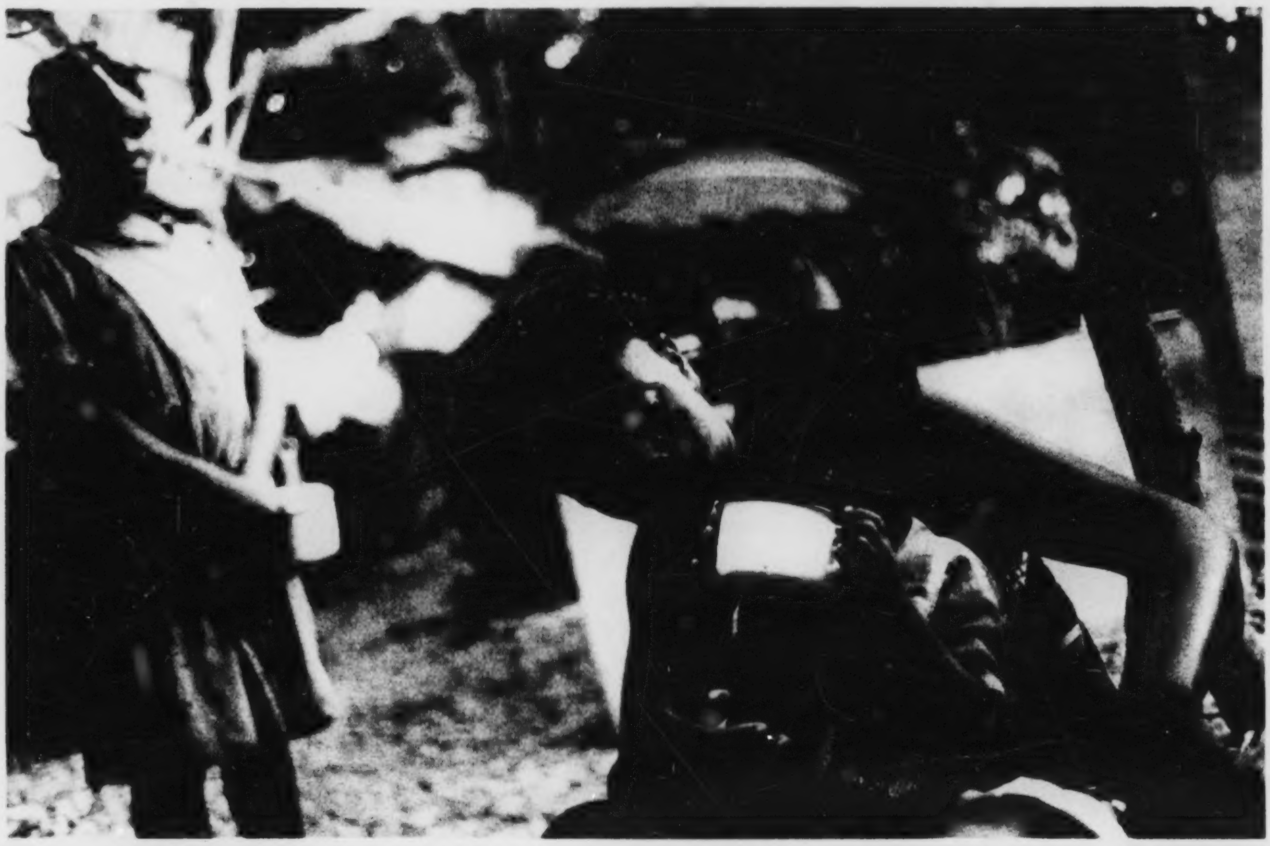
Activity Four: Water-borne Diseases

Background information follows on the next three pages. This material is taken from ***Under the Same Sun: Health***, c. 1988, pages 4-6.

Diseases are often carried by water. Water is an integral part of the life cycle of the organisms that cause major illnesses such as malaria or bilharzia.

Research and report on an illness spread by water, or an organism that causes diseases and relies on water for part of its life cycle.



CIDA Photo: Jean FrançoisLeblanc, Haiti

ENEMIES AT LARGE

The Flying Enemy

Felipe is 12 years old. He lives near the Amazon River, in northern Brazil. At around seven o'clock every morning, he walks to the school in his village. His friend Joao quit school and is now working. But Felipe's father, Manuel, insisted that his son continue his studies. He wants Felipe to have an easier life than his.

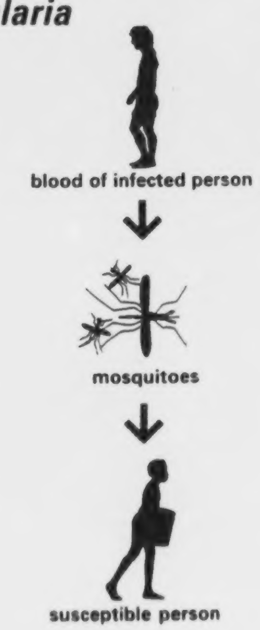
Felipe usually returns home at the beginning of the afternoon. His mother gives him a plate of rice and beans, which he devours, seated on a mat with his brothers and sisters.

Then it is time for a siesta. When he wakes up he does his homework first. If he has any time left, he will go out and fly his kite before sundown. He must go quickly, because the sun disappears early in the tropics. It drops below the horizon in a matter of minutes, like a ball rolling downhill. Felipe is very proud of his kite. He made it himself with Joao, at Christmas time.

The long summer vacation has ended now. In February, Felipe had to return to school. The rainy season has started. Felipe loves this season. One hour of rain each day and nature's colours become more vibrant.

Today, Felipe is not hungry. He has a headache. Yesterday he also complained of feeling sick. As soon as he gets home from school, he heads for his hammock. His mother is worried. What has happened to this son who is always so lively? While serving lunch to her younger children, she hears a cry. She rushes over to Felipe. He is all curled up in his hammock, his teeth are chattering and he is shivering despite the 30 degrees C. temperature of the hut. An hour later Felipe is sweating profusely. He has a high fever. Every joint in his body aches. Felipe's mother knows what this means: Felipe has malaria.

Malaria



The mosquitoes that carry malaria reproduce in water. During the rainy season, they multiply rapidly. Malaria (or paludism) is easily contracted. It takes just one single bite from an anopheles mosquito - one mosquito bite! When it bit Felipe, the insect introduced a microscopic parasite called plasmodium into his blood. This parasite penetrates the blood's red corpuscles and bursts them. That is how it attacks. The alternating periods of shivers and high fever can last several hours or several days.

If Felipe is not treated, the parasite will destroy many red corpuscles and his spleen will become enlarged. Felipe will then suffer from anemia; he will lose strength and will have more and more attacks. Malaria is never really cured. But Felipe's mother knows that the dispensary has medication that can help her son.

A million children under 5 years of age die of malaria each year.

To conquer malaria, the water where anopheles mosquitoes reproduce has to be cleaned up. Insecticides have to be used.

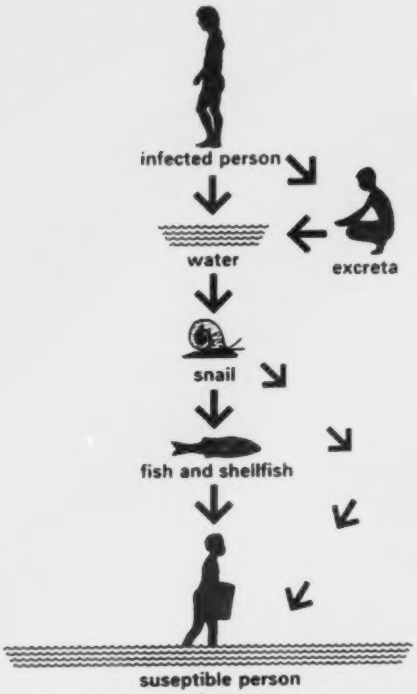
The Crawling Enemy

Dotto takes his place in line with his classmates. Like them, he is holding a small plastic cup. He is waiting to see the nurse who comes regularly to his school to analyze the students' urine samples. On the island of Zanzibar, off Tanzania, they are waging an open battle against bilharzia. Blood in the urine is one sign of the disease. Through early detection, the disease can be treated more effectively.

Dotto knows about this disease. His sister Aasha suffered from it. She had terrible itching and a very high fever. She also got very, very thin.

Prevention is better than treatment. The health officer explained this to the villagers. He told them about the dangers of contaminated water. They must stop bathing and doing their laundry in their bare feet in the pond near the village. It has to be cleaned up first. This means that it will be necessary to get rid of the water that has been polluted with excrement. It also means that all the mollusks living in the pond will have to be killed. The teacher repeats this often in class. It is in shallow water, such as in this pond, that an aquatic mollusk, a tiny snail, releases the larvae that cause bilharzia.

Bilharzia



Dotto and his friends now know the cycle of this disease. A parasite lives in contaminated pools and water bodies. The eggs of this parasite are absorbed by the snails. Inside the mollusks' intestine, the eggs develop and become larvae. The mollusks then release these larvae into the village pond. When people come in contact with the contaminated water, the larvae enter their bodies through the skin. Then the larvae spread through the blood to the liver.

If the person with bilharzia is not treated, the liver, intestines and bladder will harden and the person could die. This is what happened to Aasha.

Now it is Dotto's turn to see the nurse. He hands the nurse his small white plastic cup. The urine is passed through a filter. Then the filter is examined under the microscope to determine the presence or absence of the parasite. If the disease is diagnosed, Dotto will immediately receive the medication needed.

Dotto is a little nervous waiting for the verdict. But, the nurse has already returned, smiling. Everything is fine, once again.

Do you know what endod is?

Endod is a berry. Ethiopians pick it while it is still green and dry it in the sun. When ground up and placed in water, these berries produce a foamy detergent which can be used for doing laundry.

How is this related to bilharzia?

Scientists have just found that this foam kills the mollusks that carry bilharzia larvae. Research in this field is currently under way.

The Crawling Enemy

Bilharzia affects 300 million people every year. A million of them die from it. The chemicals needed to kill the snails cost $25,000 per tonne. The chemical treatment of bilharzia costs about $30 per person.

The Invisible Enemy

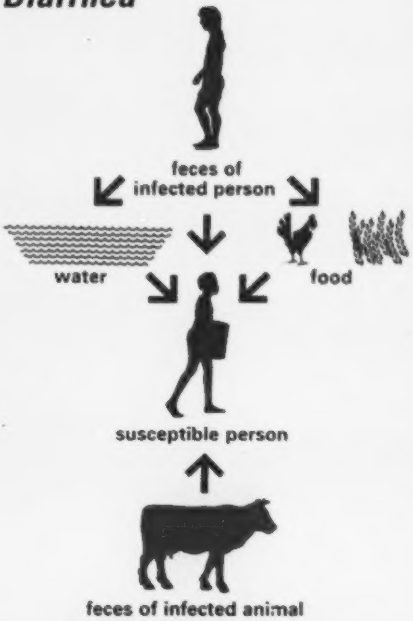
It does not take much; for example, some dirty water absorbed into the body while a child is playing in the mud around the well. This is probably what happened to Khalida, a 2 year old Bengali girl who is suffering from a terrible case of diarrhea. Her stools are liquid. She has a fever. She is vomiting. She is losing so much water that she is dehydrating; that is, she is losing her body's vital water and salts. If she is not treated immediately, she will grow weaker and thinner, and will suffer from malnutrition. Her digestive system will deteriorate and she will die, as do millions of children in the world each year.

This is not the first time Khalida has had diarrhea. Her mother, Hasina, has saved her with what she calls a miracle formula. She knew nothing of this formula until the village health officer, her cousin Kumar, taught it to her. This formula could have saved her two sons, if only she had known about it sooner. Khalida will live. Hasina ate better when she was pregnant with Khalida. She also nursed Khalida for over a year to give her a better chance of survival.

Hasina has learned to prepare this miracle formula herself. She boils some water. She fills a clean container with a little over a litre of water. She adds two large pinches of salt. Then she tastes the water. It must taste salty, but just a little - not as salty as tears are. She measures out some sugar in the same way. There must be eight times more sugar than there is salt. This is very important. Hasina gives the liquid in small amounts to Khalida; she gives a little each time, but at regular intervals. This treatment is called ORT (oral rehydration therapy). It is simple. It is inexpensive. It can be prepared at home. Hasina is confident that her little girl will get better.

And she will also know how to protect the "other one", because Hasina is expecting another baby.

Diarrhea



Diarrhea, Bilharzia and Malaria

Diarrhea, Bilharzia and malaria are three diseases that afflict developing countries. Climate is a major factor. In fact, intense heat allows bacteria, viruses and certain insects to survive and reproduce abundantly. Look at the differences in seasons here in Canada. During heat waves, bacteria proliferate and speed up the pollution of lakes and rivers.

Intense heat in June and July considerably increases the chances that beaches will be closed in August. Imagine what happens in countries where high temperatures last for the whole year.

Serious problems also arise when transportation and storage make access to safe drinking water difficult. Eliminating liquid and other waste is also a considerable problem. One cannot speak of health, without first working to solve these problems. What good is treating a child, only to see him or her, once recovered, jumping into an infested pond or drinking polluted water?

In addition to these diseases we have just spoken of, developing countries have to face other devastating and debilitating diseases. Diphtheria, whooping cough, tetanus, polio and measles are still very active. You have probably been vaccinated against the viruses that cause these diseases. But, millions of children have not yet been vaccinated, and the enemy is still at large.

Diarrhea kills between five and ten million children under five years of age each year. In other words, this deadly disease strikes ten times every minute.

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Activity Five: O.R.T. Taste Test

Source: The Canadian Red Cross Society, ***Global Report***, Red Cross International Education Programs, Number 10, 1991

Objective: Students will become familiar with the term dehydration and will learn about the causes and the signs of this disease.

Procedure:

1. Students read the article about dehydration. They then prepare the solution used in Oral Rehydration Therapy (O.R.T) and discuss the topic using the following questions:
    a) What are the possible ways that the mothers could get clean water to use in the O.R.T drink?
    b) What does the solution taste like?
    c) How many times a day do you drink liquids? How would you feel if you could not drink anything for a whole day?
    d) Have you ever suffered from vomiting and diarrhea? How did it make you feel?

Student Handout

O.R.T. Taste Test

Dehydration

The human body is about 60% liquid. There can be as much as 40 litres of water in the body of an adult. When fluid in the body is lost through illness or other causes, this is called *dehydration*.

Water forms most of our blood and the secretions from our stomach, lungs and glands. We should drink 4-8 glasses of fluid a day to keep the right amount of fluid in our bodies. It is very important that the water we drink is clean.

In some countries, there is usually no system to clean the water in rural areas. People sometimes drink water that is full of germs. This can cause vomiting and diarrhea. The illness can become very serious when it lowers the amount of liquid in the body. If a lot of body fluid is lost, the person can die.

In one Red Cross program, health workers visit mothers and teach them about the dangers of dirty water and the signs of dehydration.

A baby or small child who is dehydrated shows these signs:

- diarrhea and vomiting
- sleepiness
- fast breathing
- eyes are sunken back into the head
- no tears when the child cries
- hand, legs and feet are cold

Oral Rehydration Therapy

Oral Rehydration Therapy (or O.R.T) means that the mother can give fluids to the baby by mouth to **rehydrate** (this means an increase in the amount of fluids in the body). The health worker teaches mothers how to make the recipe for O.R.T. at home. The mother gives the O.R.T. drink to the sick child many times during the day. When mothers use O.R.T., very few babies die from dehydration.

Recipe for O.R.T.

Make the O.R.T. drink and give it to a friend.

1. Wash a 750 ml. bottle in clean soapy water, then rise it well.
2. Add 6 teaspoons of sugar to the bottle.*
3. Add 1/2 teaspoon of salt to the bottle.*
4. Fill the bottle with clean water. Mix well.

*Sugar is for energy. Salt stops the loss of fluid.

Background Information: Acid Rain

*This background information is drawn from the "Acid Rain" reprint, part of the **Down to Earth Program**, a program designed to give students a head start in their study projects on environmental topics. Use is permitted for non-commercial purposes.*

"Acid rain" is a term used to describe any form of precipitation - rain, hail, snow - that has become increasingly acidic due to air pollution. Throughout North America literally thousands on tonnes of sulphur and nitrogen oxides spew from a variety of sources - the furnaces of coal-fired generating stations, the smokestacks of ore smelters, steel mills,and chemical factories, and the exhaust pipes of buses, cars, and trucks. These activities are all taking place to produce things we want: generating stations produce electricity that we use in our homes and that is used to make other consumer goods; steel mills produce steel for cans, cars, buildings, and bridges; chemical factories produce plastics, pesticides, and more; and the buses, cars and trucks move us and the goods around.

The acids that come from industry and fossil-fuel-powered vehicles often rise high into the atmosphere where they can travel with the winds and clouds for thousands of kilometres. Eventually, however, they will come back to earth, either after being washed out of the sky by rain or simply falling out of the sky as dry particles. As acids on the ground they have a devastating effect on our environment:

- Acidifying of lakes destroying fish and small water life.
- Killing and damaging trees.
- Disruption of the food chain causing animals to readjust or starve.
- Washing out of nutrients from the ground to stunt growth of all plant life.
- Addition of dangerous metals to the water we drink.
- Corroding of building stone and metal work.

Causes

Sulphur dioxide and *nitrogen oxides* are the chief culprits. Seventy percent of the sulphur dioxide in the air is produced by coal-fired power plants, which annually pump 100 million tons of the gas out of their tall stacks into the atmosphere.

Nearly half of the nitrogen oxides come from the growing numbers of automobiles. Despite efforts to clean up car exhaust, nitrogen oxide emissions have tripled in North America since the 1950s, and doubled across Europe. The brown haze of smog is the chief result.

Natural causes, such as forest fires, volcanic eruptions, rotting woods, even lightnigh, pump tons of nitrogen oxides into the air each year. But acid rain's major sources are still man-made: a large coal-fired plant can emit in a single year as much sulphur dioxide as was blown out by the 1980 eruption of Mt. Saint Helens - some 400,000 tons.

Process and Effects

Part of the problem in studying air pollution is that it is difficult to see. The particles of sulphur dioxide and nitrogen oxide hover above the city and industrial plant that expelled them. Some smog clouds settle locally. Most are sent spiralling high into the atmosphere; their flight may last days and take them thousands of miles away. On the way these pollutants interact with sunlight, moisture, oxygen, and catalysts, to change into new, acidic chemicals of sulphur and nitrogen. The now highly acidic chemicals return to earth in the form of rain, snow, fog, frost or dew. A drop of rain so altered can contain 30 times more acid than normal.

"Potential of hydrogen", or pH, is the measure used to determine a substance's acidity. The scale runs from 1 to 14 and can be estimated by anyone, using litmus paper and a measuring scale bought at your local drug store. The more acid in a substance, the lower the number. Natural rainfall averages between pH 5.0 and 5.6; Coca-Cola has a pH value of 4; vinegar 2.2; and battery acid has a pH of 1. *Acid rain has a pH of less than 5.*

In an extreme test, Canadian scientists sacrificed an entire lake in a remote sector of Western Ontario by purposely metering in acid, to learn more about acid rain's effects on wildlife. Freshwater shrimp died first, followed by crayfish; as acidity increased, everything from snails to insect larvae disappeared. Other reports indicate that acid rain may be playing a role in declines in waterfowl and other bird populations that feed in acidic lakes.

Perhaps the greatest problem of acid rain falling on lakes and streams is that acid lakes don't really die; instead, their lifesystems are irrevocably changed. If acid rain continues, plant and animal life eventually shrivels. An overload of nitrogen feeds marine algae, which bloom into vast blankets that can block sunlight and use up the oxygen supply, smothering fish, crustaceans and plant life.

The effects of acid rain are diverse. Affected lakes and streams are no longer able to sustain many kinds of fish life. Approximately 14,000 lakes in Canada are biologically dead and, unless acid depositions are reduced, another 10,000 to 40,000 will die.

Twenty four species of birds are endangered in eastern North America as a reult of the impact of acid rain on the food chain.

Acid rain damages leaf surfaces, preventing some tree species from retaining water. Acidic water can wash out minerals such as calcium, magnesium, and potassium from leaves and from the soil, depriving plants of vital nutrients. Acids also release aluminum from the soil, which can damage tree roots, block nutrient absorption, and impair water transport, making trees more susceptible to drought, insects and disease.

Mountain forests - those closest to the acidic clouds - best illustrate the long-term effects of acid rain: growth is stunted, leaves and needles drop inexplicably, weaker trees die. Extensive forest destruction was first documented on European mountaintops in the 1970s, but has since been seen in lower altitudes as well. Although pine trees seem especially vulnerable to acid rain, hardwoods also suffer. The far-reaching effect is that the soil is weakened to a point where it cannot sustain any new growth. While more clearly evident in the heavily populated areas of Eastern Europe, the effects of acid rain have taken a toll on North American mountain ranges, from the Laurentians and Appalachians to the Sierra Nevadas. The multi-billion-dollar global timber industry has been hurt by weakened forests. The growth rates of sprice, pine, and fir in some parts of Ontario and Quebec have more than halved. This dramatic decline, caused in part by acid rain, is bad news for the forest industry, which indriectly employs 1 in 10 Canadians. The effects are not limited to nature either.

Acid-heavy water leaches important plant nutrients out of the ground and activates heavy metals such as cadmium and mercury, which contaminate water supplies.

Half the automobile corrosion in Canada may be due to acid rain.

Monuments from the Statue of Liberty to the Acropolis and are etched and worn. Statues and tablets made of bronze, limestone, marbel, and sandstone are slowly wearing away. Mayan ruins in the Yucatan of Mexico have turned black from acidic rains.

Both sulphur dioxide and nitrogen oxide emissions from cars and industry have been linked to increases in occurrence of asthma, heart disease, and lung disease, primarily among children and the elderly. The American Lung Association estimates between $16 and $40 billion is spent annually on illnesses directly related to air pollution.

The Global Impact

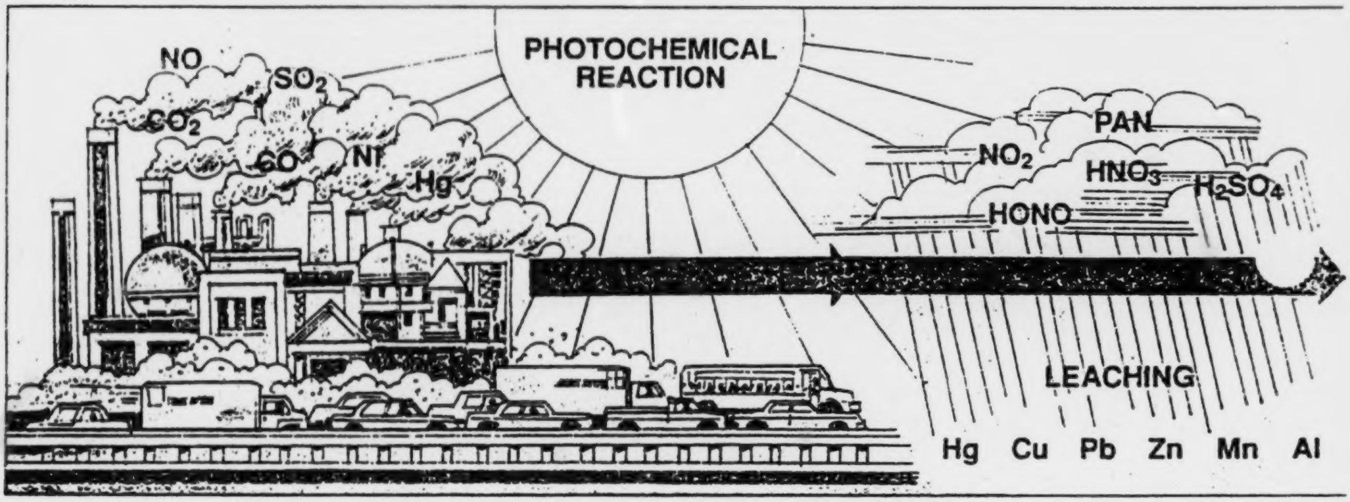
One reason acid rain has become such a widespread problem is because winds carry pollutants over vast areas; SO2 has travelled

European nations have been especially hard hit by acid rain. Fish have completely disappeared from 4,000 lakes in Sweden, in Norway 80% of the lakes have been declared technically "dead", in the central alpine region of Switzerland 43% of the pine trees are already dead or seriously damaged, and 52% of all trees in West Germany are suffering from acid rain.

In North America, the damage from acid rain is equally serious. In Ontario, sulphur and nitrogen oxides from Sudbury nickel plants have killed all vegetation and resulted in extensive soil erosion in a 20-mile area east of Sudbury. Over 300 Ontario lakes have a pH level below 5.0, while in Nove Scotia, nine rivers have pH levels below 4.7, making them incapable of supporting salmon and trout reproduction. In the United States, thousands of lakes on the eastern seaboard have been labelled "fish graveyards". Acidic damage to Canada is estimated at $1 billion per year, threatening agriculture, fishing and tourism. In the United States, total harm to forests, agriculture, and aquatic lifesystems may exceed $5 billion annually.

The Solution

To reduce acid rain and save our environment we must find ways to reduce acidic emissions. Recycling, saving electricity, reusing items and reducing automobile use are all good ways to help reduce acid rain. Making new products out of old produces less than one-tenth the acid rain created by making the same products from raw materials.



ACID RAIN STUDY TOPICS

The following are suggested topics for the further study of Acid Rain.
- What is acid rain?
- What are the different ways I am affected by acid rain?
- What is the impact of acid rain on trees? On lakes and waterways? On fish and animal life? On human health?
- How can I help reduce acid rain?
- Where does acid rain come from?
- Do all lakes become acidic?
- How acidic is the rain in my town?
- How acidic is the water we drink?
- What is the chemistry and biology of acid rain?
- How does acid rain impact on ecosystems?
- What is the dispersion of acid rain in Canada?
- What is the dispersion of acid rain, globally?
- What are we doing about acid rain:
    Consumers?
    Industry?
    Government?
- What is Canada's role in reducing acid rain generation in the United States?
- What is the developing world doing about acid rain?
- What are the economic costs of acid rain?
- What are the politics of transborder pollution?

ACID RAIN EXPERIMENTS

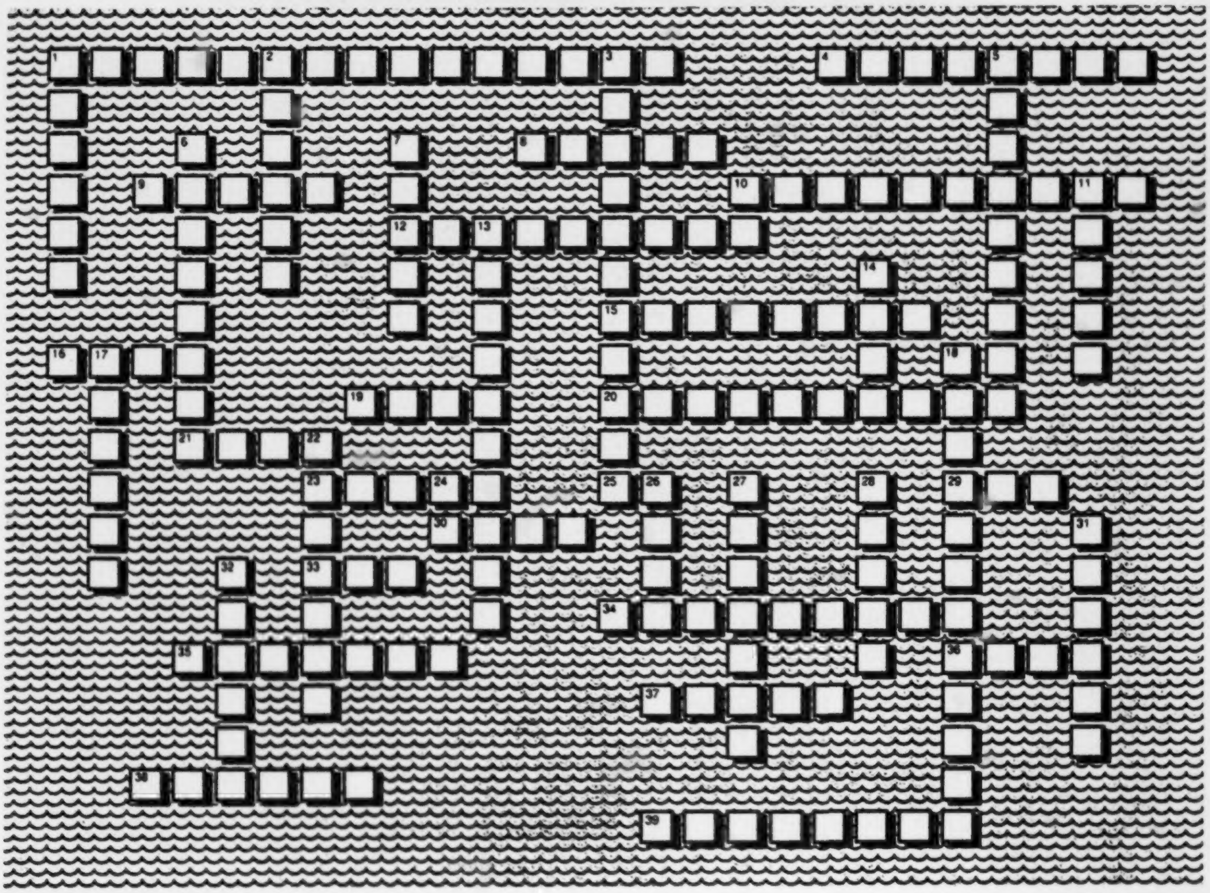
1. **Do seeds sprout and grow in acid?** Try sprouting some carrot or radish seeds in two light cotton rags or napkins; one kept damp with water and the other with vinegar. Vinegar is an acid. Record daily progress.

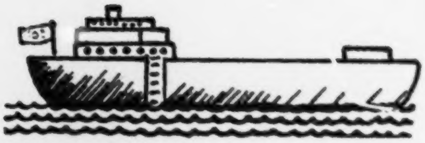
2. **Check for trees hurt by acid rain.** Look for leafless branches at the top of the tree, for leaves that are an unusual colour, for trees that don't have as many leaves as they should have and for trees that lose their leaves earlier and earlier each fall.

3. **What is the acidity of water around you?**
Collect rain water in a clean glass jar placed away from buildings and trees. Use litmus paper to test the acidity of your rain water. Also test the tap water, your local lakes and waterways. Is acid rain the same problem in Alberta as it is in Ontario? What can we do to reverse the acid rain trend?

4. **Pure Water Sources.** Most of our water comes from lakes, rivers and streams. Can you think of other sources of pure or nearly pure water that could be used without major effort or finances? Describe how the water could be collected or brought to the people who need it.

CROSSWORDS





Water Quiz

A boat is anchored at a port in Africa. It is a cargo ship waiting to be loaded with pepper destined for Canada. A hemp rope ladder hangs from the starboard side of the ship. The space between each rung of the ladder is exactly 25 cm. However, when the rope is wet the space between the rungs stretches by 5 cm.

The tide is rising at 10 cm per hour. How long will it take for the water to reach the third rung of the ladder if one rung is already flush with the water?

squatter: a person who lives on a piece of land or in an empty dwelling without permission

Across

1. Dependence upon one another.
4. Heavy rainfall.
8. Frozen mist.
9. Flowing body of water.
10. Having no colour.
12. Its capital is Jakarta.
15. Problem especially in industrialized countries (two words).
16. Daily rising and falling of the ocean level.
18. Prefix meaning together.
19. Source of potable water.
20. Action of supplying water to crops.
21. Move through water using the arms and legs.
23. Pacific, for example.
25. Opposite of SE.
29. Condensation on plants.
30. Found in a saltshaker.
33. Another word for ocean.
34. Having no odour.
35. Word to describe land overflowed with water.
36. A continent.
37. Group of African countries fighting drought.
38. Timbuktu is found in this continent.
39. First word in CIDA.

Down

1. An ocean.
2. Sahara, for example.
3. Participation in a common effort.
5. Pollution or waste sometimes found in water.
6. Containers for holding water (plural).
7. Quench a thirst.
10. Abbreviation of California.
11. Water in its gaseous state.
13. Remove salt from seawater.
14. Condensation on a pane of glass.
17. Land surrounded by water.
18. Accumulation of water molecules due to a cooling effect.
22. Asia's rainy season.
24. As right __________ rain.
26. Natural movement of air.
27. Lack of water.
28. H_2O
31. Country name hidden in AAANDC.
32. Separate pollution from water.

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Answers to Crosswords

Across

1. interdependance
4. downpour
8. frost
9. river
10. colourless
12. Indonesia
15. acid rain (2 works)
16. tide
18. co
19. well
20. irrigation
21. swim
23. ocean
25. NW
29. dew
30. salt
33. sea
34. odourless
35. flooded
36. Asia
37. Sahel
38. Africa
39. Canadian

Down

1. Indian
2. desert
3. cooperation
5. pollution
6. pitchers
7. drink
10. ca
11. steam
13. desalinate
14. mist
17. island
18. condensation
22. monsoon
24. as
26. wind
27. drought
28. water
31. Canada
32. filter

Answer to Water Quiz

A ship floats on water, so it rises with the tide!

Source: **Under the Same Sun: Water**, CIDA Youth Editions, page 9

Unit 2

Living Things And Biodiversity

CIDA Photo: Ron Watts, Pakistan

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THEME: BIODIVERSITY

Alberta Program of Studies Curriculum Fit

Grade 7, Unit 1: **Characteristics of Living Things**

SPECIFIC LEARNER EXPECTATIONS

Attitudes

Students will be encouraged to develop:

- appreciation of the beauty and complexity of living things.
- commitment to the care of living things.
- appreciation of the adaptive value of structural and behavioral characteristics of plants and animals

Skills

Students will demonstrate the following science inquiry skills:

- Questioning
  - recognizing patterns and discrepant events
  - identifying and asking relevant questions

- Proposing Ideas
  - hypothesizing
  - predicting

- Gathering Data

- Processing Data
  - identifying patterns and trends

- Interpreting Data
  - inferring the relationship of living things to their environments
  - inferring the value of adaptations based on observations of living things
  - developing theoretical explanations

Concepts

The study of living things is based on observation, classification and interpretation.

Students will be expected to:

- recognize the role of observation, classification and interpretation in the scientific study of living things.
- identify and describe characteristics of living things: in particular their ability to grow and reproduce; their ability to respond to environments; and their ability to produce or take in food.

The concept of adaptation provides a basis for interpreting the structures and behaviours of living things.

Students will be expected to:

- identify examples of adaptive structures
- identify examples of adaptive behaviours.

Grade 9, Unit 1: **Diversity of Living Things**

SPECIFIC LEARNER EXPECTATIONS

Attitudes

Students will be encouraged to develop:

- awareness and appreciation of the diversity of life forms.
- awareness and appreciation of the interrelatedness of life forms
- awareness of the effects of human actions in increasing or decreasing the diversity of living things.

Skills

Students will demonstrate the following science inquiry skills:

- Questioning:
    - identifying and asking relevant questions
    - Proposing ideas:
    - hypothesizing about the relationships among specific living things

- Interpreting Data
  - inferring evidence of relationships among living things
  - interpreting variations of living things

Concepts

- Living things show a diversity of structural and behavioral adaptations
- Artificial selection provides a basis for the enhancement of desired characteristics of domesticated plants and animals
- Individual living things can be interpreted as members of groups of organisms that share common features.

"Living things show a diversity of structural and behavioral adaptations."

BACKGROUND INFORMATION **BIODIVERSITY**

*This information is drawn from **Seeds of Change**, a resource package on biodiversity developed for teachers. Used with permission.*

What is Biodiversity?

BIODIVERSITY comes from 'bios' (meaning life) and 'diversitas' (meaning variety). If refers to the variety, and variability, of living organisms and their ecosystems. Biodiversity includes diversity within species (genetic diversity), among species, and among ecosystems."

Why Plants Vanish:

There are many reasons why our planet's plants are disappearing. Some include:
*plants may be unable to adapt to climate changes
*plants disappear as forests are lost or its resources are harvested
*plants disappear when farmland is lost to the spread of cities
*plants may become extinct when the soil is severely eroded by wind, washed away by heavy rains or polluted by repetitive use of chemical fertilizers
*plants disappear because of market pressures as farmers switch to commercial production of single varieties.

It is estimated that a quarter of the world's plant species may vanish in the next 50 years.

Why Should I Care if Plants Disappear?

Plants provide us with many essentials of life such as different foods, types of clothing and a variety of medicines.

Different plants have different characteristics and properties. Some plants grow in hot, humid climates, while others flourish in cooler, dryer climates; they vary in size, colour, texture and taste. Because plants are like other living species, their defining characteristics are determined by genes. When a plant species vanishes, so do its genes. It is this genetic material which creates diversity within and between species. As the plant gene pool shrinks, so do our options for such things as:
*developing seeds which will produce food in a changing environment
*developing medicines to combat a variety of the illnesses affecting people and animals.

Food and Biodiversity

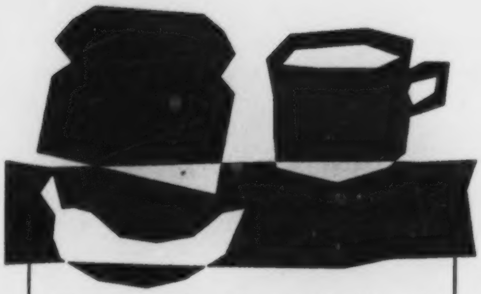
"A mere total of 20 food plants provides 90 percent of our food - yet walk into any North American supermarket and you will see products from as many as 100 different plants, some of which were unknown to us even a few years ago."

(Our Common Bowl - Global Food Interdependence: IDRC 1992)

Breakfast on the World

"Before you finish eating breakfast this morning, you will have depended on half the world. This is the way our universe is structured... We aren't going to have peace on earth until we recognize this basic fact of the interrelated structure of all reality."

(Martin Luther King Jr)



Today's Breakfast Special:

Coffee
served up from Kenya

Sugar for your coffee
from the Dominican Republic

Whole Wheat Toast
brought to you from Canada

Jam for your toast
compliments of the Balkans

Bananas
fresh from Costa Rica

Food for Thought

For centuries, men and women around the world have planted seeds which would produce good, nutritious food for their communities. Local farmers traditionally developed and maintained many seed varieties, selecting the ones that they could best preserve and store, that could produce food under different climatic conditions, and that would result in crops that could be harvested using local methods.

In the 1960s and 1970s when new high-yielding seeds were developed, many farmers replaced their traditional seeds with these new varieties. This sparked the "green revolution" increasing our food production with seeds capable of producing more food per acre than ever before. However, these new varieties were more dependent on chemical fertilizers, irrigation and pesticides.

India once grew 30,000 varieties of rice. Today more than 75 per cent of its total rice production comes from fewer than 10 varieties. In 1904, 7,098 varieties of apples were grown in the United States. Since then, more than 86 per cent of those varieties have disappeared. The same story can be told the world over as thousands of varieties of food-producing seeds are lost.

From potatoes developed in the Andes to corn grown for centuries in South America, our modern-day diet relies on the existence of diverse seeds that can continue to produce our food.

Women have for centuries been selecting seeds which produce nutritious food in a variety of growing conditions. Farmers in many developing countries are women who plant, weed and harvest local crops.

Wheat fields all look the same to me

The Case for Diversity

The diversity of seeds plays a fundamental role in our ability to continue to feed a growing population in our changing environment. The following excerpt from "The World's Food Supply at Risk: National Geographic, Vol.179, No.4, April, 1991", illustrates the link between the existence of diverse seeds and our ability to maintain a secure food supply.

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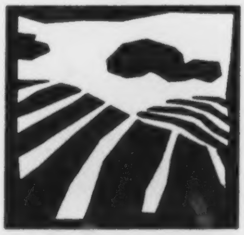
At present rates of extinction, as many as 60,000 plant species – one-fourth of the world's total – may be lost or endangered within the next 50 years.



"Clear-cutting across virgin lands destroys valuable natural vegetation, and in tropical rain forests – home to half the earth's plant and animal species – some 60 acres a minute are denuded. A quarter of the total falls to the saw-toothed bite of commercial timber operations. The resulting loss of naturally diverse germplasm – much of it not yet studied – is called genetic erosion. It is estimated that by the middle of the next century, one-quarter of the world's 250,000 plant species may vanish – victims of deforestation, the shift to monocultures, overgrazing, water-control projects and urbanization...

Scientists transfer genes between related plants by traditional cross-pollination techniques, or in recent experiments, through genetic engineering. Genetic engineers identify a section of the plant's DNA from which they wish to borrow material. Then, using chemicals, they extract the segment, isolate the gene in a solution, and splice it into the DNA of another plant. In its new home the gene goes to work, repelling insects or fighting diseases just as it had done before. But biotechnologists cannot invent the gene. That must come from wild sources or from one of the many varieties – which scientists call landraces – traditionally bred by farmers...

Ironically, the loss of genetic diversity accelerated with the green revolution of the 1960s. Back then, with the best intentions, scientists developed new 'miracle' seeds by carefully crossbreeding plants to increase food production – mostly rice and wheat – in poor nations. The results were dramatic. The new seeds, resistant to insects and diseases, yielded millions of additional tons of grain a year. The miracle seeds were not perfect, however. Opportunistic insects and viruses mutated and unlocked the genetic resistance of the new seeds. These pests sent scientists scurrying, searching for genes to withstand the threats. Although they have been successful so far, the old varieties and wild plants are disappearing from many places as they are replaced by improved crops that are genetically uniform...

The trend toward single-variety monoculture, the planting of one strain instead of many varieties, leaves modern plant breeders little margin for error. At present rates of extinction, as many as 60,000 plant species – one-quarter of the world's total – may be lost or endangered within the next 50 years. Meanwhile, there are more mouths than ever to feed.

When farmers began harvesting the first domesticated plants about 8000 B.C., the earth's population was around four million. Today that many people are born every 10 days. If the trend continues beyond the year 2000, we will have to grow as much food in the first two decades of the new century as was produced over the past 10,000 years. The key for meeting that monumental demand for food may be wild plants. Inside each seed is the germplasm containing its DNA, the genetic code evolved over millions of years in the wild, that dictates each plant's development. This 'stuff of life' determines a plant's resistance to pests, disease, drought and similar natural catastrophes. The germplasm controls the taste, appearance, and preserving qualities of food as well."

(Excerpted from: *World's Food Supply at Risk:*
National Geographic, Volume 179, Number 4, April, 1991.)

Genetic Erosion

The following is an excerpt from "A Patent on Life Ownership of Plant and Animal Resources" published by the International Development Research Centre.

"Since the dawn of agriculture, many thousands of years ago, farmers have continually sought to improve the crops they have grown. As agricultural communities spread around the globe, they took their crops with them and, through continual selection, developed a vast array of different types, known as landraces, adapted to different environments and needs. This variation provides the main raw material for crop improvement today and for the future.

Unfortunately, much of this diversity is now threatened. Many of the traditionally grown landraces have been replaced by "modern" varieties. Indeed, it is ironic that the success of plant breeding has itself been a major cause of the loss of the raw material on which future advances in crop improvement depend. Instead of a huge patchwork of different landraces of a crop, many parts of the world are now covered by a comparatively small number of varieties that themselves are often closely related.

The success of plant breeding has itself been a major cause of the loss of the raw material on which future advances in crop improvement depend.

The requirements of modern agriculture for uniform product, whether for field mechanization or processing, have further exacerbated the situation. In addition, for a variety to be eligible for plant breeders' rights, it must be sufficiently uniform to be able to distinguish it from other varieties — again resulting in less variation than is commonly found within traditional landraces.

As modern plant breeding extends its impact to more and more crop species and in ever more agricultural environments, so traditional genetic diversity is being progressively lost. The situation, referred to as genetic erosion, is now critical for many species and in many parts of the world.

The replacement of landraces by new varieties is, however, not the only cause of genetic erosion. As food habits change, or as shifts occur in the profitability of certain crops compared to others, the total area grown to a particular crop also can change dramatically. Whatever the reason for abandoning certain crops, there is a great danger in losing the variation that originally occurred within them. If, in the future, trends are reversed, much of the variation needed to revive a crop and to adapt it to the new conditions will no longer occur.

In addition to the loss of landraces, many wild species related to cultivated types and, hence, also of value in future crop improvement, are also threatened. This can occur when their habitats are destroyed through the expansion of urban areas, deforestation, or the widespread degradation of ecosystems caused by overgrazing. The situation is expected to get worse in the future if global climatic change occurs and leads to major shifts in plant ecosystems. Again, an ironic situation — climate change resulting in the loss of genetic diversity that itself will be badly needed to tailor our crops to produce adequately under new climatic conditions.

The seriousness of the situation increasingly is being recognized and attempts to redress it are taking place throughout the world. Many countries have established gene banks to preserve traditional landraces, varieties, and wild species in cold storage. Efforts are also being made to conserve materials in the field, either on farms in the case of traditional landraces and varieties, or in special habitat reserves in the case of wild species.

These efforts, although impressive, remain inadequate. Additional funding and other resources, as well as further knowledge about optimum conservation methods and strategies, are urgently required. The situation is especially acute in some of the developing countries — the very countries that have given rise to so much of the genetic variation used throughout the world today."

(Excerpted from: *A Patent on Life Ownership of Plant and Animal Resources:* IDRC, 1991)

Women and Biodiversity

The following is an excerpt from the article "Women and Biodiversity: Ancient Reality, Modern Imperative" which appeared in the February 1992 issue of *Development*, a publication of the Society for International Development. The article examines the fundamental role women play in preserving our earth's biodiversity.

"Environmental degradation is often both a cause and an effect of the lifelong hardship that is commonly the lot of rural women in the developing world. As primary resource users, these women do much of the hard work needed to maintain or restore the surrounding environment – often in the face of great odds against success. But many of them are also the agents of environmental degradation simply because they shoulder the heavy workload needed to keep their families fed, housed, and clothed. Only through sustainable development can this downward spiral of poverty and habitat destruction be reversed.

In most of the developing world, women bear primary responsibility for growing and collecting food, medicines, fuel and housing materials and for providing cash income for schooling, health care, and other family needs. When development plans fail to take these duties into account, they lead not only to biotic impoverishment, but also to human impoverishment.

Since rural women must know their environment intimately to subsist in it, they are experts on forest, crops, soils, water management, medicinal plants, growing techniques, and seed varieties. But their knowledge is rarely recognized, much less tapped by development planners, scientists, or field workers.

Although the relationship between women and biodiversity is relatively new as an area of study, it has been a central reality since the dawn of civilization. If we hope to secure a healthy planet and better lives for generations now living and those to come, all of us who expect to survive the passing of this century and the coming of the next must recognize and support the crucial link between women and the integrity of the inheritance of the earth's plant and animal life."

(Excerpted from: "Women and Biodiversity: Ancient Reality, Modern Imperative"
Development Society for International Development, 1992)

Words to Know

1. Biodiversity – the word is derived from 'bios' (meaning life) and 'diversitas' (meaning variety). It is "the variety, and variability, of living organisms and their ecosystems. Biodiversity includes diversity within species (genetic diversity), among species, and among ecosystems." (IDRC)

2. Biotechnology – "Any technology that is applied to living organisms to make them more valuable to people." (WRI, "Global Biodiversity Strategy", 1992)

3. Centre of diversity – An area of great genetic variance of a plant species. A centre of diversity is usually the area of the oldest and widest cultivation of a crop.

4. Centre of origin – A specific geographic area in which a plant species originated.

5. Hybrid – The offspring of parents from different plant races, breeds, etc.

6. Gene bank – A controlled environmental facility where germplasm is stored as seeds, pollen or tissue.

7. Gene pool – Total number of genes or gene complexes in a plant population.

8. Germplasm – "The genetic material, especially its specific molecular and chemical consitution, that comprises the physical basis of the inherited qualities of an organism." (WRI, 1992)

9. Genetic erosion – Loss of (crop) genetic diversity caused by a multitude of factors, including environmental degradation, the replacement of traditional seeds and other changes in agricultural practices.

10. Green revolution – Period in the 1960s and 1970s when new plant varieties, which responded well to fertilizers and irrigation methods, were introduced primarily into developing countries.

11. Landrace – "A crop cultivar or animal breed that evolved with and has been genetically improved by traditional agriculturalists, but has not been influenced by modern breeding parctices". (WRI, 1992) Landraces are also referred to as folk seeds.

12. Patent – "A government grant of temporary monopoly rights on innovative processes or products." (WRI, 1992) In some countries, plant varieties or even specific genes of a plant can be patented.

13. Plant breeder's rights – In some countries, the breeder of a distinct, uniform plant variety can obtain a plant breeder's rights certificate conferring certain privileges with respect to the use of the variety; the nature of these privileges differs in each context.

14. Intellectual property rights – "A right enabling an inventor to exclude imitators from the market for a limited time." (WRI, 1992)

15. Seed – The seed is the part of a plant customarily used to reproduce the plant. It contains the genetic information of the plant and the nutrients needed for the seed embryo to survive and grow.

16. Genes – An element of the germplasm that controls the transmission of a hereditary characteristic.

17. North-South – The term North refers to industrialized countries usually located in the northern hemisphere, while the term South refers to developing countries usually located in the southern hemisphere

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Activity 1: Human Incinerator

Observation is an essential attribute of the scientist. Each of us individually and collectively as a society asks selected questions of our surroundings, and the answers we find help determine how we view the world. Because we all ask different questions, we have differing world views; but within our collective society we agree on the basics. The Western tradition has been influenced by an empirical, rational approach to reality, while other traditions are more holistic and are often based on a spiritual approach.

In our culture, we first observe ourselves and those in our immediate circle. Then we extrapolate to the wider world. In this activity, students are invited to look at their own eating habits as they begin to think about diversity and variety. As the activities in this section proceed, students move from themselves and their community to the world community. As they observe the variety and diversity in their own lives, they may begin to ask questions about why that diversity is shrinking and what they can do to stop or reverse the trend to species extinction.

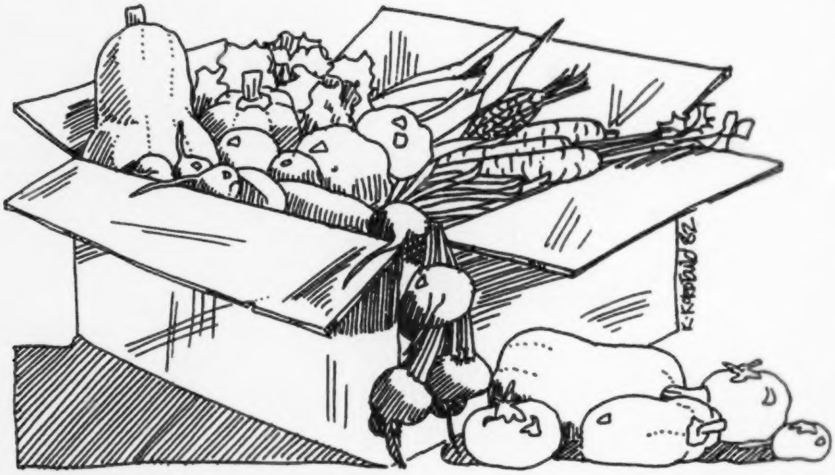
1. Make an ingestion web of all the foods you eat in one day.

2. Complete the attached table.

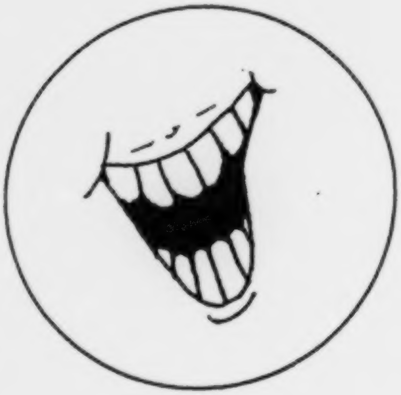
    a) Is your diet varied or always the same?
    b) Do you prefer variety or the same thing each day?
    c) Imagine you no longer have wheat available in any form. Take out all the foods you wouldn't be able to eat. How would this change your eating habits?
    d) Is it important to maintain diversity or can we afford to lose many varieties of grains?

Origin of Some Common Foods

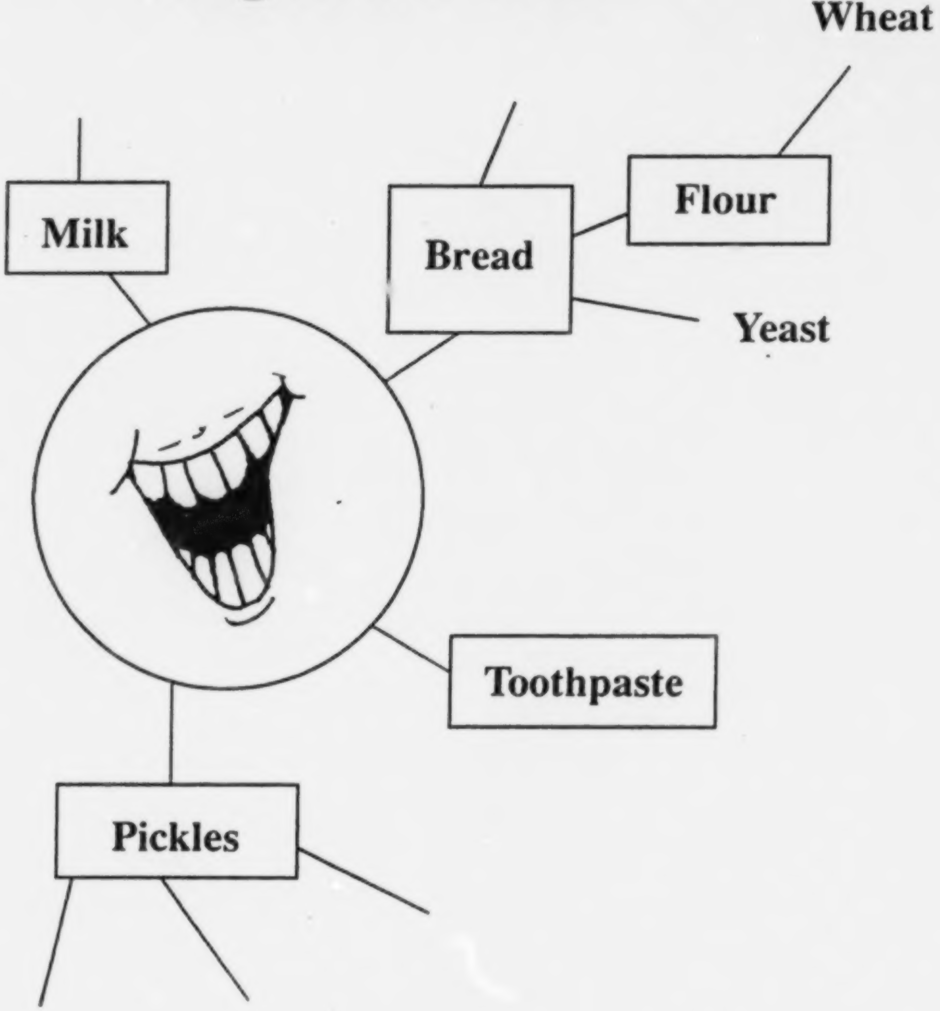
North America	berries
Andes	potato, peanut, tomato, cocoa
Africa	bread wheat, African rice, sorghum, coffee, pearl millet, watermelon
China	rice, soybean, orange, tea, foxtail millet, welsh onion, radish
Euro-Siberia	clovers, spelt wheat
South East Asia	rice, banana, coconut, sugar cane, yam, lemon/lime, mango
Central Asia	apple, carrot, garlic, onion, grape, peach
Central America	corn, common bean, sweet potato, cassava, papaya, pumpkin, grapefruit
Near East	wheat, rye, barley, pea, leek, lentil, plum
Mediterranean	oats, sugar beets, cabbage, celery
India-Myanmar	rice, jute, dwarf wheat, black pepper, cucumber



Human Incinerator Ingestion Web



Example of Human Incinerator Ingestion Web



Human Incinerator Table

Substance	Basic Food Group	Ingredients	Origin	

CIDA Photo: David Barbour, Philippines

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Activity 2: Supermarket Tour

"Before you finish eating breakfast this morning, you will have depended on half the world. This is the way our universe is structured... We aren't going to have peace on earth until we recognize this basic fact of the interrelated structure of all reality."

Why Should We Care if Plants Disappear?

Plants provide us with many essentials of life such as different foods, types of clothing and a variety of medicines.

Different plants have different characteristics and properties. Some plants grow in hot, humid climates, while others flourish in cooler, dryer climates; they vary in size, colour, texture and taste. Because plants are like other living species, their defining characteristics are determined by genes. When a plant species vanishes, so do its genes. It is this genetic material which creates diversity within and between species. As the plant gene pool shrinks, so do our options for such things as developing seeds which will produce food in a changing environment and developing medicines to combat a variety of the illnesses affecting people and animals. (Seeds of Change, p. 1)

There are 12,000 food products in our grocery stores, but most come from 20 key food plants, none of which originated in North America. At one time, 30,000 rice varieties were grown in India. Now, only 12 are grown there. We've lost three quarters of the world's genetic diversity in our food crops in the last fifty years. We once had 7,000 varieties of apples; 6,000 are extinct now.

Our choices are not as varied as we think. While there may be 50 varieties of cereals on the grocery shelves, only four grains are used: wheat, oats, corn and rice.

Activity:

1. Ask students to brainstorm responses, both positive and negative, to the issue, "Should we preserve the biodiversity of cereal grains?" "Why should we care if we have a variety of types of cereal grains?" Discuss.

2. Have students visit the cereal shelves in a grocery store in pairs. They are to complete the attached chart.

Name of Cereal	Oats	Wheat	Rye	Rice	Other

a) How many different kinds of grain did you find in the cereals?

b) Did you find any grains that you had not heard of before? Where are they from?

c) Were you surprised that so few different grains were used in so many kinds of cereal?

d) What would happen if one of these grains became extinct? How many kinds of cereal would disappear?

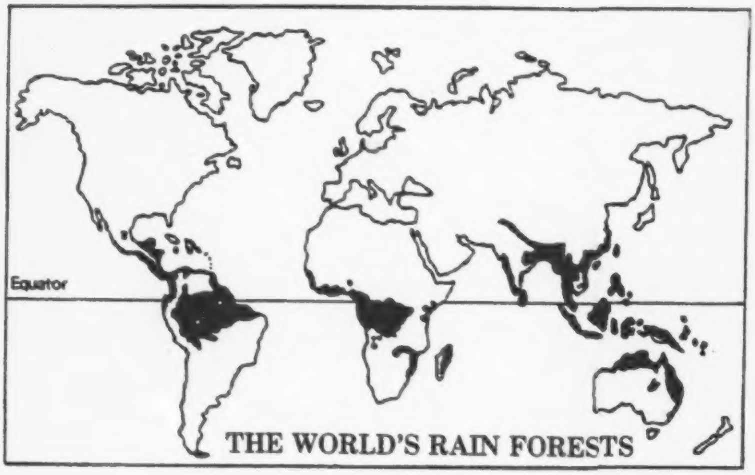
FORESTS: BACKGROUND READING

The loss of biological diversity poses an unprecedented crisis for our planet. In a single lifetime, more than half the species on earth are in danger of being lost forever due to the destruction of the rain forests alone. The loss of genetic diversity among species makes those that survive more vulnerable to diseases and other disasters.

The richness and diversity of life forms is one of our least recognized natural resources. For example, relatively few of the millions of Amazonian plant species have been evaluated for medicinal uses, yet 70 per cent of new cancer drugs are made from plants native to tropical rain forests. While you are reading these words, a plant species that could cure some type of cancer may be wiped out forever.

Protecting biodiversity goes beyond preserving individual endangered species. The very web of life is fraying. Only by taking active steps to restore damaged ecosystems and to balance our needs with those of other species can we hope to reverse the slide toward extinction of species that threatens the stability and resilience of life on earth.

The similarities between destruction of forest biodiversity, even in the name of forest industry, in Canada and in such other parts of the world as Brazil and Ethiopia and Nepal are striking. Three sets of background material follow, each of which can be used by teachers and groups of students according to their interests and abilities.



Fact Sheet: Forests, Ecosystems and Economics

Prepared by the Consumers' Association of Canada (Ontario)

234 Eglinton Avenue East, Suite 304, Toronto, ON M4P 1K5

Did you know?

- The forest products industry provides nearly one million jobs in Canada: 240,000 directly, and 725,000 in support.
- Canada, with 19% of the market, is the world's largest exporter of manufactured forest products.
- In 1989, the total harvest of timber of all species in Canada was almost 186 million cubic metres.
- Canada has 10% of the world's forest area.
- Forest products bring Canada more net foreign exchange ($22.9 billion in 1992) than any other industry.
- Canada is number one in newsprint, with 31% of total world production.
- 80% of Canada's forest area is controlled by the Provinces. The federal government controls 11% and approximately 9% is privately owned.
- Each year, Canadian industry cuts 247,000 acres (100,000 hectares) more forest than it plants.
- 60% of forest fires are caused by humans, and 36% by lightning.
- A single newspaper subscription is equivalent to using one tree every 10-12 weeks.

What is a forest ecosystem?

Forest ecosystems (consisting of open water, marsh, grassland and forests) capture, convert and store energy from the sun; produce oxygen and consume carbon dioxide; create fertile soil; store, purify and release water gradually; provide wildlife habitats; filter, detoxify pollutants and waste products free of change; and are usually capable of self maintaining and self-renewing.

The forest ecosystem has six major features: interdependence, diversity, resilience, adaptability, unpredictability and limits. Understanding these enables us to recognize how exploiting lumber by clear cutting, building factories, roads, cities and other changes that affect the forest's biological communities have far-reaching and unpredictable consequences.

How does it work?

In a forest ecosystem all biotic (living organisms) and abiotic (non-living environmental factors) components function together as one open system interchanging nutrients, energy and biochemical substances. They maintain a dynamic equilibrium at different stages of ecological succession and at mature community stage.

Every organism, including the forest floor plants and animals, have specific roles in nutrient recycling or in symbiotic assistance to trees for growth. For example, many poisonous mushrooms are known to be essential for tree growth. Without them trees in northern forests take up nutrients very poorly and grow slowly. Similarly many of the forest floor grasses and sedges protect soil from erosion and absorb heavy metals in their roots.

Further research into forest floor plants and their biochemical relationships to trees may reveal other very subtle relationships.

Managing forests

Forest management consists of a cycle of decisions and events. Each cycle of management between planting and harvesting is called a rotation. The major steps in this cycle include making an inventory of the site, developing a forest management plan, preparing the site for harvest, harvesting commercially valuable timber, and regenerating and managing the site before the next harvest.

There are two basic forest management systems:

i) Even-aged management. It begins with the cutting of all or most trees from a diverse, old-growth or secondary forest. Then the site is replanted with an even aged stand of a single species or few faster growing species of softwoods or replanted naturally.

ii) Uneven aged management. Trees in a stand are maintained at many ages and sizes to permit continuous natural regeneration. Here the goals are to sustain biological diversity; sustain long-term production of high-quality timber; provide a reasonable economic return and allow multiple use of a forest stand.

The method chosen for harvesting depends on whether uneven or even aged forest management is used. It also depends on the tree species involved, the nature of the site and the objectives and the resources.

A managed forest has approximately equal areas of regeneration, immature and mature trees. Canada's forests are in a transitional stage, moving from a wild forest to a managed one.

The total Canadian reserve of usable timber is about 24 billion cubic metres, of which 66% is softwood stands, 14% is hardwood stands, and 20% is mixed.

Three major species - spruce, pine and fir - account for 75% of the softwood. Aspen and poplar, both of which are short-lived and fast-growing, make up over 50% of the hardwood.

Improper logging practices has resulted in massive soil erosion and land disturbances. Some consequences of this are: landslides; floods; silting up of lakes or rivers; and loss of fertile topsoil, which reduces forest productivity, and prevents regeneration.

Planting of non-regenerated areas needs to be national top priority.

Environmental effects

On the forests

There is evidence that acid rain, ozone layer depletion and build-up of greenhouse gases pose a serious threat to global forest and aquatic ecosystems.

Recent studies confirm that acid rain may be reducing soil fertility and forest growth. Acidified water tends to pick up increased amount of aluminum which interferes with the absorption rate of water and nutrients by tree roots.

Acid rain is weakening trees and making them more susceptible to attacks by disease, insects, drought and fungi that thrive under acidic conditions.

Acid rain and ozone layer depletion are killing and reducing productivity of many species of phytoplanktons (major producers of aquatic ecosystems).

Research in West Germany indicate that trees are absorbing nitrogen, a major component of car emissions, through their tops, not their roots. The fact that the trees are now being fed from their tops is making the root system week. The root systems are turning black and they are dying. This unusual nitrogen absorption is producing many physiological anomalies previously unseen in trees.

By the forest industry

Canadian pulp and paper mills are extremely hard on aquatic ecosystems. Nearly half of the untreated effluent discharged into our waters comes from the paper and pulp industry; besides, they add numerous halogenated and non-halogenated organic compounds which directly impact on aquatic living organisms and sediments.

Poor management practises such as clear cutting cause erosion and loss of top soil and nutrients. These pollute the waterways and reduce the productivity of the aquatic ecosystems.

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What can be done

Pollution prevention

In late 1991, the federal government released a new regulating package. This regulation requires all manufacturers using chlorine bleaching to ensure that dioxins and furans in their effluents are not measurable by 1994.

A plan to phase out chlorine bleaching over a ten year period has been adopted by the British Columbia Government. Ontario is likely to adopt a similar strategy.

The Consumers Association of Canada and other environmental groups are advocating the principle of zero discharge by which they mean preventing pollution by changing production processes so that toxic substances are not discharged.

Between 1960 and 1989, on a per tonne basis, effluent was reduced by 52%, suspended solids by almost 92% and biochemical oxygen demand by about 77%.

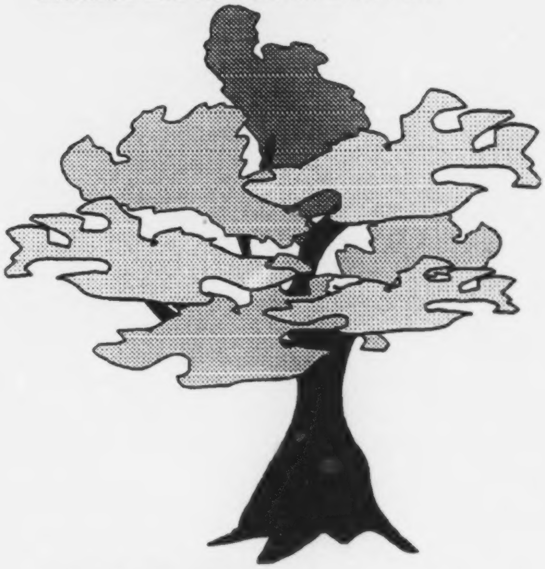
Forest management

When a degraded forest ecosystem is abandoned, in most cases it will eventually restore itself, at least partially, through ecological succession. But this process takes a long time. By studying how natural ecosystems recover from severe stresses, ecologists are learning to speed up the repair of environments that have been damaged by human activity. Environmentally degraded ecosystems can either be rehabilitated or restored.

Rehabilitation ecology involves making degraded forest land useful for exploitation on a sustainable basis. Terraces can be built along the contours across the slopes and planted with native grass species to retain water and hold the soil in place. Small check dams can be built across gullies. Planting fast growing useful indigenous trees will help to reforest the slopes at a faster rate and protect soil.

Restoration ecology takes a degraded forest site and re-establishes a community of organisms close to what would be found naturally. You determine the strongest types of natural growth, protect them and then remove all plants and animal species not native to the area to be restored.

An ambitious forest restoration project is being carried out in a dry tropical forest in Guanacaste National Park in northwest Costa Rica. The idea is to make the nearly 40,000 people who live near the area an integral part of the restoration of 70,000 hectares. By actively participating in the project, local residents will reap enormous educational, economic and environmental benefits.



Public Participation

Programs can be initiated in forest areas near towns that rely on one or two forest industries. The restoration area would become a living classroom. Students in grade school, high school, and universities will study ecology of the restoration area. There should be educational programs for civic groups and tourists from across Canada.

These projects in eastern and western Canada will also serve as nucleus training grounds in restoration ecology thereby training students that would further help restore other degraded forest lands and improve marginal private and public forest lands.

Rehabilitation of damaged ecosystems coupled with preservation of natural areas will help us maintain the vital biological diversity of our land.

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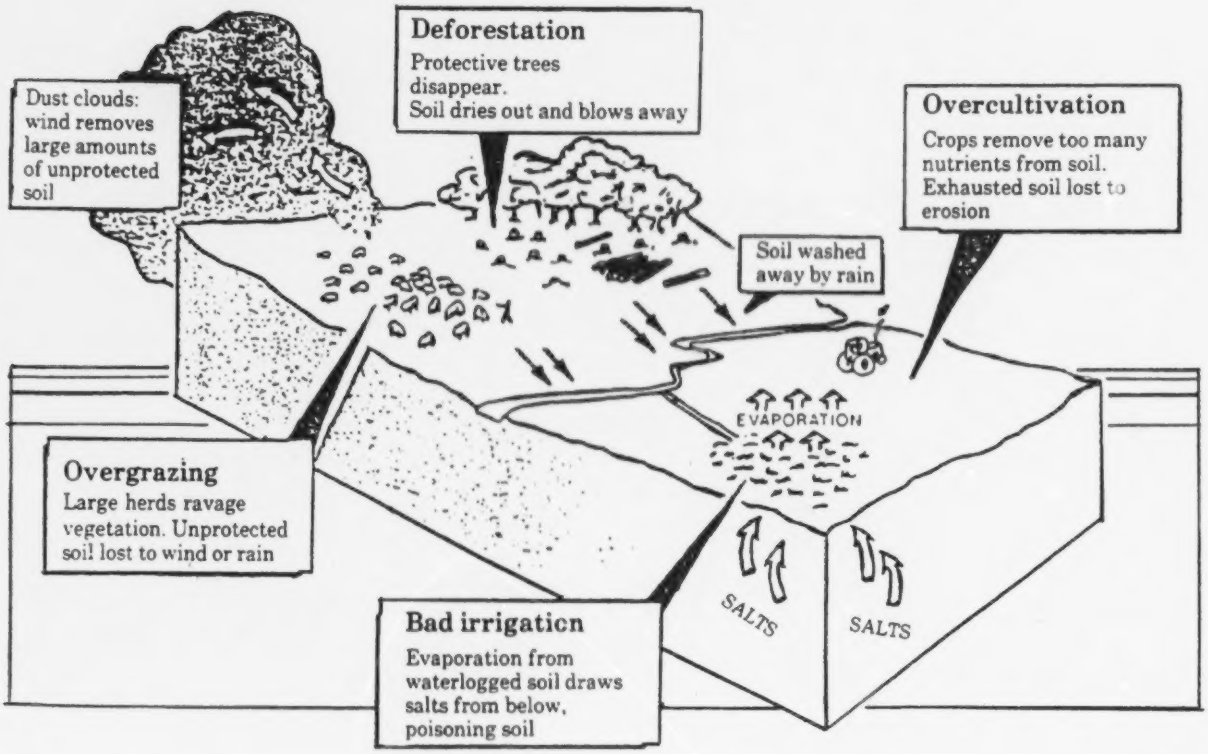
The Vicious Cycle

Soil degradation....................Deforestation......................Desertification

Fifty years ago, thick forests teeming with wild animals covered the land. Today, only a few fig and acacia trees stand out above the nearly barren ground. Deep gullies scar the terrain. Wildlife has been reduced to scavenging hyenas and baboons.

This land is in Ethiopia, although the description could apply to many areas of Africa. A combination of population pressure, poor agricultural management and drought has led to the deterioration of the land. Gradually, without anyone quite realizing it, the trees were taken, the grasslands overgrazed and the topsoil washed away. Wood became hard to find and expensive, the soil poor, and enough pasture for the animals difficult to provide. The people were not used to planting crops, let alone trees, and so could not arrest the problem.

How Fields Become Deserts


Dust clouds: wind removes large amounts of unprotected soil
Deforestation
Protective trees disappear. Soil dries out and blows away
Overcultivation
Crops remove too many nutrients from soil. Exhausted soil lost to erosion
Soil washed away by rain
EVAPORATION
Overgrazing
Large herds ravage vegetation. Unprotected soil lost to wind or rain
Bad irrigation
Evaporation from waterlogged soil draws salts from below, poisoning soil
SALTS
SALTS

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Collaborating with enemy number one

There has been a terrible sandstorm blowing for weeks now. Clouds of dust fill the streets of Nouakchott, the capital of the West African country of Mauritania, with dirt. People stay inside as much as possible. But even inside it is hard to keep out the dust. It means constant sweeping.

Hug sandhills are covering the tarmac road between Nouakchott and the town of Boutilimit, 150 kilometres inland. Sand is killing the country. Sand is enemy number one.

The main concern of experts and officials is to fight this sand. Large scale irrigation projects are being carried out along the River Senegal by international agencies. But desertification still continues. Rainfall figures are dropping each year. Natural vegetation has almost disappeared. There is hardly any livestock left. People are migrating south and to Nouakchott.

Those who stay behind are starting to look for other ways to survive. Farmers put up thorn branches in a curve on an open field. Sand blows there, close to the surface, like a white snow drifting over the dark, greyish soil. But the thorn branches, brought from a nearby old riverbed, hold this sand during the dry season, enough to build up a natural dam before the rainy season starts. This natural dam will collect enough of the less than 200 millimetres of rainfall to grow a crop of millet or sorghum.

People are using simple techniques to survive desertification. Instead of fighting the desert, they are collaborating with it. A small area, maybe only half a hectare, is planted with sorghum. Trees are planted along the side of the field. Instead of large irrigation and reforestation programs, both expensive and risky, this offers the possibility of adopting farming techniques to the natural situation. No heavy equipment is needed, no motor pumps or other water lifting techniques that can easily break down. And there will need to be creative solutions: over 88% of the dryland area in Sudano-Sahelian Africa is already desertified.

Source: Bart K. Tijman, Lutheran World Service

Activity 3: A World in a Metre

Objective: to illustrate the diversity of different environments.

Procedure:

1. Have students perform an inventory of the species they can collect or observe in an area of one square metre. Teams of students can investigate different settings: a park, a nature reserve, the school grounds, a pond or stream, a city sidewalk.

2. Have students prepare a map of their metre, display their findings and compare results.

Adapted from Race to Save the Planet, Environmental Issues Across the Curriculum. WGBH Educational Foundation, 1990.

CIDA Photo: B. Paton, Zimbabwe

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Simply... a tree for all seasons

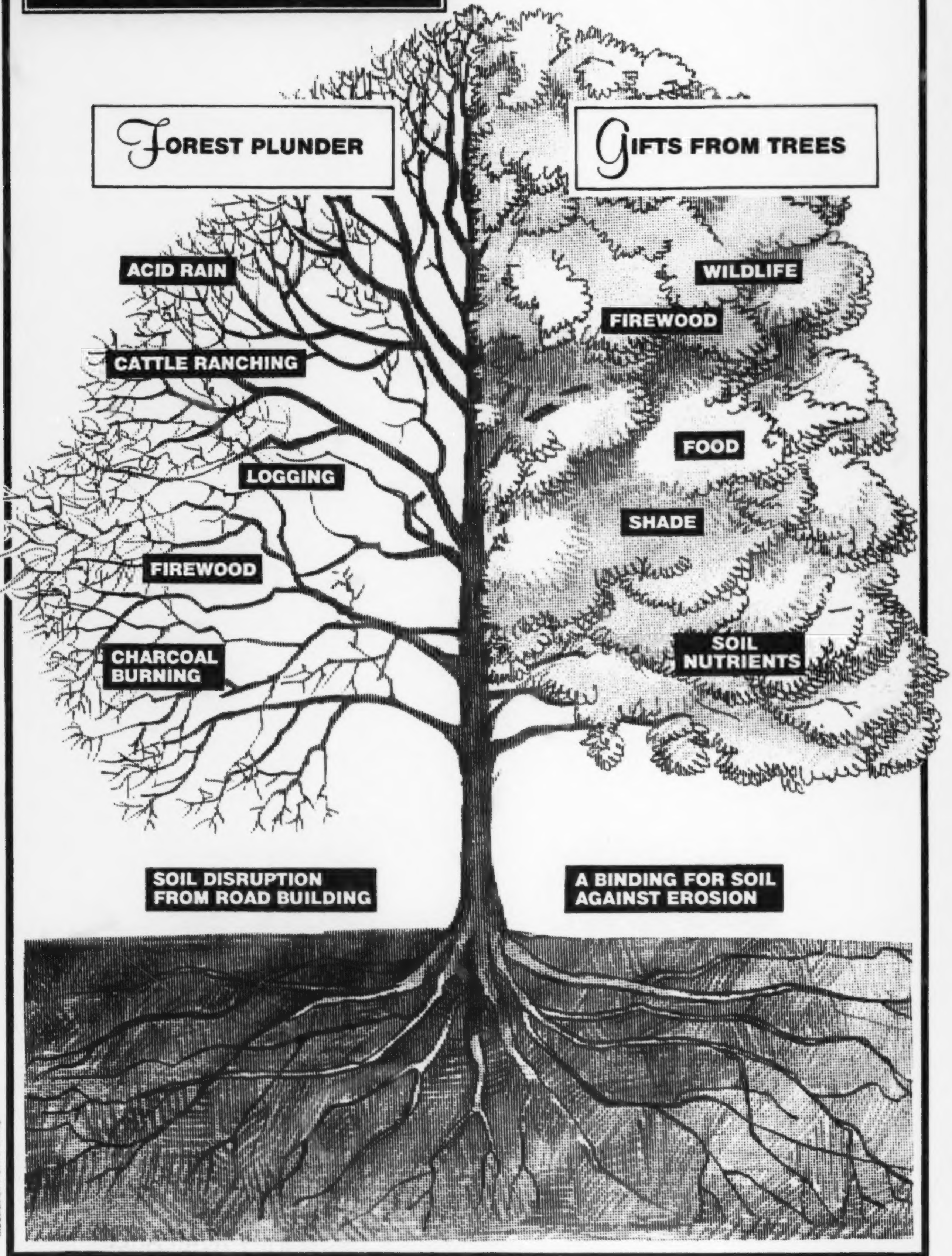

Illustration : Clive Offley

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Activity 4: Forest Role Play

Source: Y Care International, The YMCA's World Development Agency, London. E17 3DZ. Phone: 011-44-181-520-5599

Objective: To demonstrate the diversity of the many different animals and plants that live in the rainforest and their importance to each other.

Procedure:

1. Explain that you are going to give people roles to play in a tropical rainforest.
   a) Pass out role cards

   b) Have the students spend about five minutes reading their card and deciding on an appropriate movement, voice, and personality to go with their role while mingling with the others.

2. Once everyone is ready, the students move around each other having conversations. The aim of the conversations is to discover what connections they have with each of the other characters in the forest.

3. Encourage students to act out their roles rather than reading out what is on the role card.

4. As an alternative to the role play, try this shorter exercise:

   a) Make enough cards for each member of the group, each card having one of the ten parts of the rainforest written on it in large letters.

   b) Without people seeing what is on their card, attach it to the back of their collar with a paper clip.

   c) When everyone is "labelled", allow members of the group to try to find out what they are by asking other people one question only each, with Yes/No answers (eg., am I a plant? can I run? **not** what am I?).

   d) When most people have discovered their role, make sure that those who haven't are helped to work it out.

Conclusion:

Discuss the "connections" the students discovered. Have students choose one of the ten roles and write a paragraph on what they think would happen if that part of the rainforest ceased to exist.

Forest Role Cards

Trees

You are the most striking feature of the forest! Full grown trees form a green canopy of leaves above the ground all year round, tapping sunlight to make food out of carbon dioxide and water. You shade the rest of the forest below making it dim. Your roots in the soil take up nutrients and water. Many other plants and animals live on you; monkeys eating your fruit, bugs under your bark, birds nesting in your branches, butterflies drinking your flower nectar, forest people using your wood for boats and houses, climbing plants hanging from you, and many other examples. There are a huge number of different kinds of trees, many providing useful products such as rubber, oils, medicinal products, and probably many others yet to be discovered. When you die, you come crashing down leaving a gap allowing direct sunlight to reach the forest floor and young trees to grow up and take your place. You are decomposed by insects, fungi, and bacteria, helping to recycle you.

Water

You come in many forms and are essential for life. Most of the chemical reactions of life happen in a water solution. You are produced all the time as living things process their food. You travel from soil into and through the plants by carrying nutrients, and you are combined with carbon dioxide by the energy of sunlight to make food for the plant. You evaporate, mostly from the leaves of plants, into the air keeping it humid so that things rarely dry out in the forest. When the warm air rises, it cools and you condense into water droplets forming clouds. You rain in torrential downpours nearly every day, watering the forest, flowing in streams and rivers that are home to many animals and plants and which provide transport for people.

Sunshine

You are the source of energy for the forest. All the green plants use your light to make food. Only a small amount of light gets as far as the ground through the thick vegetation. Here in the tropics, you are always high in the sky at midday and very strong all year round. Your warmth, heating the forest, helps make all the chemical reactions of life go faster than in a cold climate. Your heating effect evaporates water and warms the air which rises causing thick rain clouds to form, giving downpours nearly every day.

Soil

You are made up of many different kinds of material: pieces of rock and clay, both large and microscopic, water with many different chemicals dissolved in it, decaying plants and animals, and air spaces too. The roots of plants grow through you and draw in your minerals and water. They help to hold you together, preventing you from being washed away. You are home to many different animals: worms, beetles, millipedes, and many others who feed on you and the other life within you, such as the millions of microscopic bacteria, fungi, and other organisms. You are the place where dead things and droppings are broken down into forms which are used again by the forest; hence you are constantly changing.

Insects

There are millions of different kinds of you, all living in different ways: butterflies, moths, beetles, ants, wasps, bugs, mosquitoes, and many more. Some eat leaves or fruit. Some feed on nectar or pollen from flowers. Some catch other insects or small organisms, or suck the blood of larger animals. Other insects feed on dead plants and animals and so are important in recycling nutrients. You are also eaten by other animals, sometimes plants too. Most insects have two or more stages to their lives and the larvae may lead a very different life from the adults. Many insects have a very particular lifestyle; eg., only living on a particular kind of tree, at a particular height, while that tree may only be pollinated by that particular insect.

Air

You fill all the gaps in the forest, wherever there is space around and within the other things. You are made up of different gases: nitrogen, oxygen, carbon dioxide and others, as well as water vapour. Your oxygen is vital for animal life in the forest; nearly all living things use it to obtain energy from their food. Carbon dioxide and water are produced as a result. Green plants use the carbon dioxide to make food, giving off oxygen. So you are constantly changing but maintain a balance; if this is upset, it will have drastic effects on life. When warmed up, you rise above the forest. As you rise, you cool and the water vapour in you forms droplets making clouds. Within the forest you are usually fairly still but when you move at any speed you are called "wind". You are always mixing with air from other parts of the world.

Smaller Plants

There are lots of plants other than trees in the forest. Many of you live below the trees on the dimly lit forest floor. Others are climbers such as lianas and passion flowers. Some, such as many orchids and ferns, are "epiphytes" living on the trees with no roots in the soil. There are also water plants who live in streams, rivers and pools. Just like trees, you need light, air, nutrients and water. Some plants get extra nutrients by catching and digesting insects. Flowering plants need to be pollinated by wind, water droplets, insects, birds, bats or other animals. Like all other living things, when you die, you are recycled and used again either by being eaten or decomposing in the soil.

Birds

There are many different kinds of you, each living in different ways. Most of you nest in trees. Some of you eat insects or other animals like frogs and spiders. Some of you feed on nectar from flowers and are important because you pollinate them so that they can form their fruit. Many birds eat fruit and seed from the trees or smaller plants, and you many be important in spreading the seed to new places where they can grow. Large birds of prey may eat other birds or large animals such as monkeys. Birds are themselves eaten by larger animals or forest people, or else when you die you are decomposed by bacteria and other small living things, returning nutrients to the soil.

Forest People

Your ancestors have lived in the forest for thousands of years, so you know all about how to live there. The forest provides everything you need for life. You eat food that you either hunt, gather or grow. You are skilled at making houses and boats from trees, and you know which plants are good for medicines or poisons. You live in small villages and will move to another place after a few years. The forest grows over your settlement and eventually recovers. Because there are only small numbers of you and the forest is large, this does not permanently damage the forest. You are concerned because recently a lot of people from far away have moved in and cut down huge areas of forest saying that the land belongs to them. The forest is your home, gives you things for life, and you have a great respect and love for it. Like all other things, when you die, you will be recycled.

Large Animals

You include a variety of animals such as monkeys and other apes, bats (big ones!), large cats, snakes, mongoose, and lots more, each with a different way of life. Large carnivores, such as tigers, feed on other animals and have no natural enemies except humans. Apes and bats tend to eat fruit or leaves, but also eat some insects and other animals; they may be eaten by larger carnivores or humans. Things that animals cannot digest and waste products are all returned to the soil in their droppings. Like most other living things, you use air and water and will eventually die and be recycled. You large animals are fewer in number than the smaller living things and are more spaced out in the forest, needing a large area of land to support each of you. The forest is your home and if much of it is destroyed, you will lack the right food, suffer from overcrowding or even have nowhere to live at all.

Activity 5: The Web of Life

Source: Y Care International, The YMCA's World Development Agency, London. E17 3DZ. Phone 011-44-181-520-5599

Objectives:

To show how different plants and animals are dependent on one another. If one is destroyed, all the other organisms which are dependent upon it are affected.

Procedure:

1. Have everyone stand in a circle and give a ball or wool to each person. Explain that the wool is to be used to make lines of connection between the different characters in the rain forest.

2. Have them tie the loose end of their ball or wool around their waist.

3. When they agree with someone else in the circle that they have a connection with each others' role in the forest, they throw their balls of wool to each other, pass the wool around their waists and throw the balls back. Repeat this with other people until a complete web of connections is made (or the wool runs out).

4. When it looks like the web is complete, then ask everyone to gently move backwards so that the web is pulled taut.

   a) Ask people to look at the web and consider how all the elements in a rain forest support each other.

   b) Comment on how this could also represent the whole planet, where seas, rives, atmosphere, land and living communities are all interdependent.

5. Now get a sharp pair of scissors and explain that they represent the threats to life in the rain forest and the planet. Make cuts into the web one by one and explain what they represent:

a) Cut one: trees are felled for making paper and furniture business, destroying the habitat for plants, animals, and forest peoples.
b) Cut two: the land is cleared for cattle ranching to feed the western hamburger market and the soil is left bare to be washed or blown away.
c) Cut three: the lack of vegetation causes a drop in rainfall and what was forest becomes desert.
d) Cut four: Towns and industry are developed causing pollution of air, soil and water.
e) Cut five: the loss of forests and the burning of coal, oil and gas cause changes of climate worldwide over many years.
f) Cut six: oppressed and poverty stricken people fight for their rights. Wars are fuelled by the arms trade and military aid from the Western world.

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6. Ask the group to call out more examples of threats to life, either at home or abroad, or on a global scale. They may be specific things as above, or generalizations such as greed, violence, apathy, etc. Make more cuts as they call them out until the web collapses.

Follow-up:

How did people feel seeing the web collapse? What things in their own lives and society contribute to the threats to life? How can we protect the web? What things or actions in their own lives and society offer protection?

CIDA Photo: Virginia Boyd, Guyana

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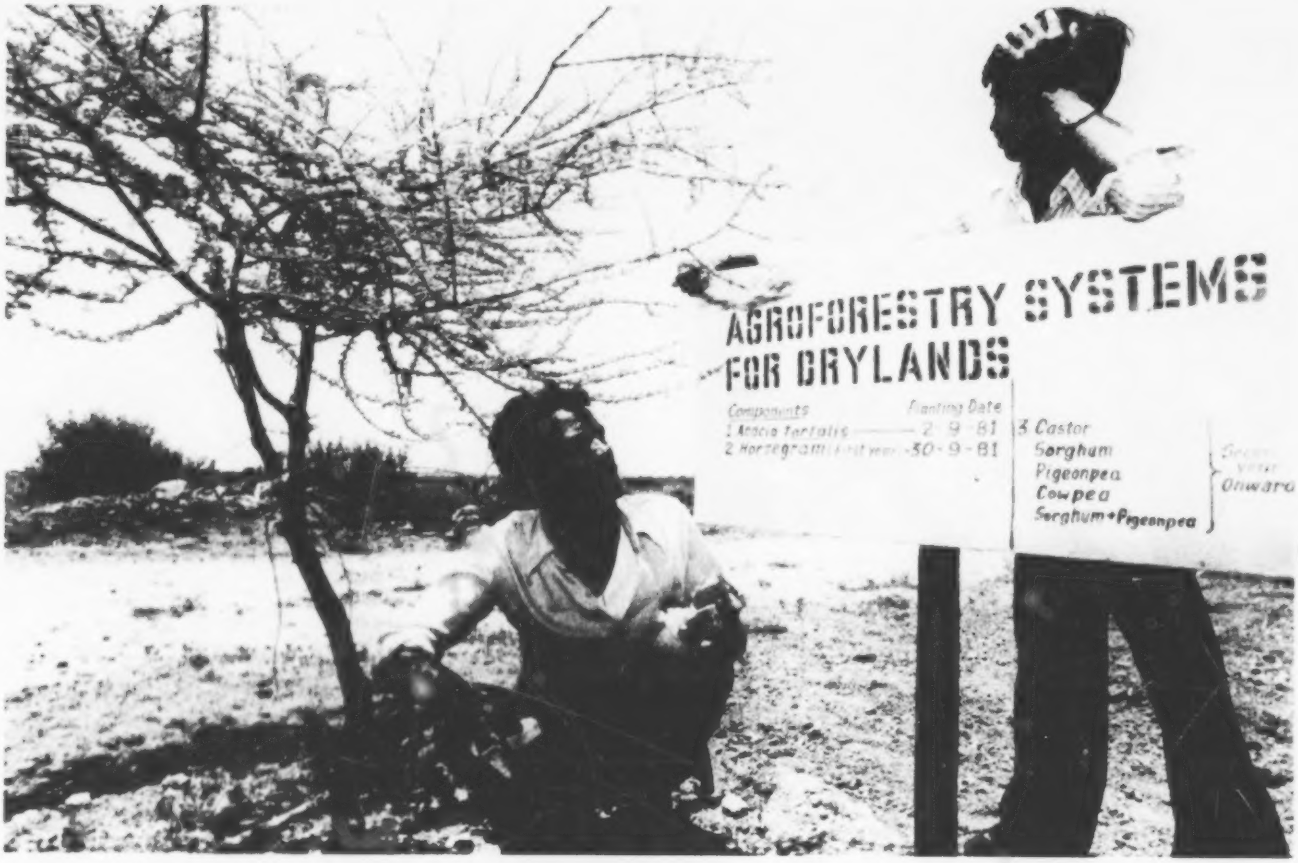

CIDA Photo: Dilip Mehta, India

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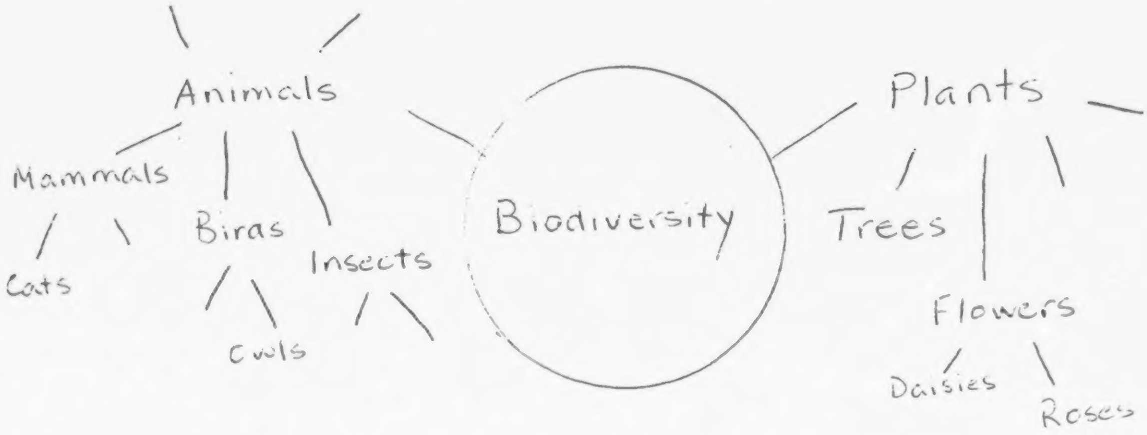
Activity 6: Webbing Biodiversity

Procedure:

1. Elicit the following web from the students.



2. Have students research how many kinds there are of each species.

3. Speculate on the question, What happens to the web when types of species disappear? Is it important to preserve species? What steps might we have to take to ensure that we don't lose species?

4. The vast majority of the earth's species are invertebrates. Without insects, life on the planet would change radically. Yet the endangerment of insects, a critical consequence of deforestation, doesn't have the same impact on us as if it is a cute seal. Have students research the role of invertebrates in the ecosystem, then hold a competition among teams of students to see which team can develop the best ad campaign, using posters, radio jingles, and print or television ads to heighten public awareness about the need to protect invertebrate life. *Adapted from Race to Save the Planet, Environmental Issues Across the Curriculum. WGBH Educational Foundation, 1990.*

Activity 7: I Should Think Knot!

Objective: To help students recognize the incredible variety of products that comes from the forest.

Procedure:

1. Make a list of things in the classroom that use wood or wood products.
2. Choose an afternoon when you will try to work **without** using these items.
3. Put a star next to the items you cannot do without. Add to your list as you discover new items.
4. Research Alberta's forest industry. At what rate are trees being cut down? Are they being replanted at the same rate? How many trees does it take to produce the amount of paper you have in your classroom? How could you save some of these trees? Is it important to preserve our forests? Why?

Suggestions for expansion:

1. Forest Management is an issue, not only in Alberta, but in forested areas around the world. Our forests are disappearing at a tremendous rate. Native rights, fisheries, jobs, pollution, and over-consumption of forest products are world-wide problems. Organize a class discussion or debate over the future directions we should take in Alberta to manage our forests so that our descendants will have this resource as well.

2. Jobs, jobs, jobs. This is a rallying cry often heard at the end of the Twentieth Century. Have students make a class chart showing connections to plants through jobs.

   Some work areas to consider are:
      - forest industry
      - farming
      - gardening
      - cooking, baking

   Have students ask their parents about their work. Talk about: what they do, tools they use, products they make, products they use, and special clothes or equipment they need.
   How are these jobs related to the forest industry?
   What would you like to do when you grow up?
   Make a job web to show how your career might be related to the forest industry.

Activity 9: The Hierarchical Kingdom

Introduction:

We often refer to wilderness as untamed, implying that we view ourselves as tamers, standing outside of nature and acting on it. This rational, Cartesian-Newtonian model of nature which separates the observer from the observed, has been blamed for the massive exploitation and destruction of the environment that we are experiencing today.

On the other hand, if life really is an interconnected system and we really live on a finite and intricately interrelated planet, we need a holistic world view in which everything and everybody wins. This implies the breaking down of a hierarchy that puts men at the top, with women and children below man, followed by animals, plants and nature, or wilderness.

Objective: to understand and appreciate alternative ways of viewing the place of humanity in the web of life.

Procedure:

1. Read Chief Seattle's speech to the students.
2. Have students look at a less human-centred view of nature by researching and acting out the myths and folktales of other traditions - Native American, ancient Greek, African, etc.
3. Have each student prepare a mask, costume, or poster relevant to a particular story and use it to dramatize or tell the story.
4. Discuss how different religions or traditions view the human relationship with other species and with nature as a whole.

Follow-up:

If possible, invite a native elder into the classroom to explain the medicine wheel, emphasizing the holistic nature of the native world view.

STEWARDSHIP OF THE COMMONS

Chief Seattle, 1854

By a little church on Bainbridge Island, within sight of the modern city of Seattle to whom he gave his name, lies the carefully-tended grave of a great Indian orator, Chief Sealth (spelled Seattle by early white settlers). While fearing the intentions of white men, he had welcomed them nonetheless and even accepted their God, becoming a Christian. He died in his eighties in June 1866.

Twelve years earlier in his native language, he spoke elegantly at an assembly of tribes preparing to sign treaties with the whites who had overrun their lands. Dr. Smith, a young Seattle pioneer, took down what he said, maintaining he had not been able to render the full beauty of the great chief's imagery and thought.

The Great Chief in Washington sends word that he wishes to buy our land.
The Great Chief also sends us words of friendship and good will. This is king of him, since we know he has little need of our friendship in return.

But we will consider your offer. For we know that if we do not sell, the white man may come with guns and take our land. How can you buy or sell the sky, the warmth of the land? The idea is strange to us.

If we do not own the freshness of the air and the sparkle of the water, how can you buy them?

Every part of this earth is sacred to my people. Every shining pine needle, every sandy shore, every mist in the dark woods, every clearing and humming insect is holy in the memory and experience of my people. The sap which courses through the trees carries the memories of the red man.

The white man's dead forget the country of their birth when they go to walk among the stars. Our dead never forget this beautiful earth, for it is the mother of the red man. We are part of the earth and it is part of us.

The perfumed flowers are our sisters; the deer, the horse, the great eagle, these are our brothers. The rocky crests, the juices of the meadows, the body heat of the pony, and people - all belong to the same family.

So, when the Great Chief in Washington sends word that he wishes to buy our land, he asks much of us.

The Great Chief sends word he will reserve us a place so that we can live comfortably to ourselves. He will be our father and we will be his children.

So we will consider your offer to buy our land. But it will not be easy. For this land is sacred to us.

This shining water that moves in the streams and rivers is not just water but the blood of our ancestors. If we sell you land you must remember that it is sacred and that each ghostly reflection in the clear water of the lakes tells of events and memories in the life of my people. The water's murmur is the voice of my father's father.

The rivers are our brothers, they quench our thirst. the rivers carry our canoes, and feed our children. If we sell you our land, you must remember, and teach your children, that the rivers are our brothers, and yours, and you must henceforth give the rivers the kindness you would give any brother.

The red man has always retreated before the advancing white man, as the mist of the mountains runs before the morning sun. But the ashes of our fathers are sacred. Their graves are holy ground, and so these hills, these trees, this portion of the earth is consecrated to us. We know that the white man does not understand our ways. One portion of land is the same to him as the next, for he is a stranger who comes in the night and takes from the land whatever he needs. The earth is not his brother, but his enemy, and when he has conquered it, he moves on. He leaves his fathers' graves behind, and he does not care. He kidnaps the earth from his children. He does not care. His fathers' graves and his children's birthright are forgotten. He treats his mother, the earth, and his brother, the sky, as things to be bought, plundered, sold like sheep or bright beads. His appetite will devour the earth and leave behind only a desert.

I do not know. Our ways are different from your ways. the sight of your cities pains the eyes of the red man. But perhaps it is because the red man is a savage and does not understand.

There is no quiet place in the white man's cities. No place to hear the unfurling of leaves in spring or the rustle of insect's wings. But perhaps it is because I am a savage and do not understand. The clatter only seems to insult the ears. And what is there to life if a man cannot hear the lonely cry of the whippoorwill or the arguments of the frogs around a pond at night? I am a red man and do not understand. The Indian prefers the soft sound of the wind darting over the face of a pond, and the smell of the wind itself, cleansed by a midday rain or scented with the pinion pine.

The air is precious to the red man for all things share the same breath - the beast, the tree, the man, they all share the same breath. The white man does not seem to notice the air he breathes. Like a man dying for many days, he is numb to the stench. But if we sell you our land, you must remember that the air is precious to us, that the air shares its spirit with all the life it supports. The wind that gave our grandfather his first breath also receives his last sigh. And the wind must also give our children the spirit of life. And if we sell you our land, you must keep it apart and sacred, as a place where even the white man can go to taste the wind that is sweetened by the meadow's flowers.

So we will consider your offer to buy our land. If we decide to accept, I will make one condition: the white man must treat the beasts of this land as his brothers.

I am a savage and I do not understand any other way. I have seen a thousand rotting buffalos on the prairie, left by the white man who shot them from a passing train. I am a savage and I do not understand how the smoking iron horse can be more important than the buffalo that we kill only to stay alive.

You must teach your children that the ground beneath their feet is the ashes of our grandfathers. So that they will respect the land, tell your children that the earth is rich with the lives of our kin. Teach your children what we have taught our children, that the earth is our mother. Whatever befalls the earth befalls the sons of the earth. If men spit upon the ground, they spit upon themselves.

This we know. The earth does not belong to us; we belong to the earth. This we know. All things are connected like the blood which unites one family. All things are connected.
Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself.

But we will consider your offer to go to the reservation you have for my people. We will live apart, and in peace. It matters little where we spend the rest of our days. Our children have seen their fathers humbled in defeat. Our warriors have felt shame, and after defeat they turn their days in idleness and contaminate their bodies with sweet foods and strong drink. It matters little where we pass the rest of our days. They are not many. a few more hours, a few more winters, and none of the children of the great tribes that once lived on this earth or that roam now in small bands in the woods will be left to mourn the graves of a people once as powerful and hopeful as yours. But why should I mourn the passing of my people? Tribes are made of men, nothing more. Men come and go, like the waves of the sea.

Even the white man, whose God walks and talks with him as friend to friend, cannot be exempt from the common destiny. We may be brothers after all; we shall see. One thing we know, which the white man may one day discover - our God is the same God. You may think now that you own Him as you wish to own our land, but you cannot. He is the God of all and His compassion is equal for the red man and the white. This earth is precious to Him and to harm the earth is to heap contempt on its Creator. The whites too shall pass; perhaps sooner than all other tribes. Continue to contaminate your bed, and you will one night suffocate in your own waste.

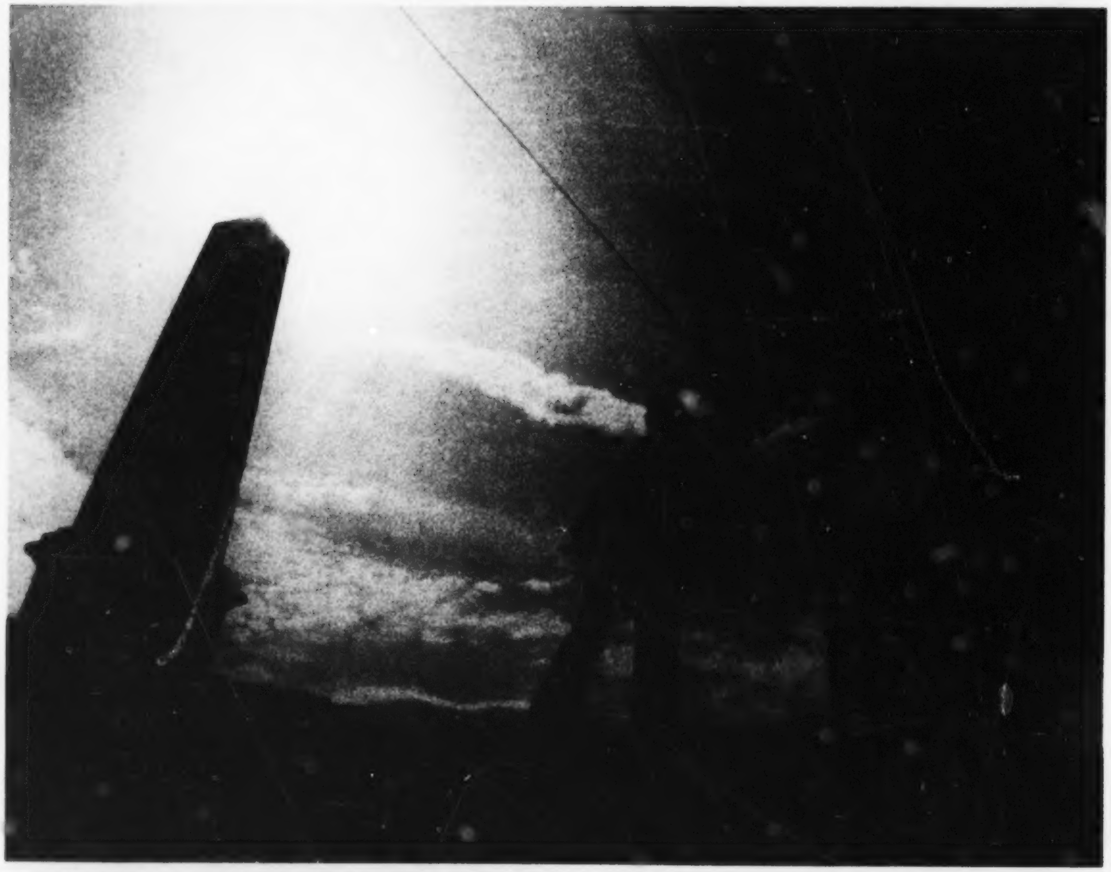
But in your perishing you will shine brightly, fired by the strength of the God who brought you to this land and for some special purpose gave you dominion over this land and over the red man. That destiny is a mystery to us, for we do not understand when the buffalo are all slaughtered, the wild horses are tamed, the secret corners of the forest heavy with the scent of may people and the view of the ripe hills blotted by talking wires.

Where is the thicket? Gone. Where is the eagle? Gone. And what is it to say goodbye to the swift pony and the hunt? The end of living and the beginning of survival.

So we will consider your offer to buy our land. If we agree it will be to secure the reservation you have promised. There, perhaps, we may live out our brief days as we wish. When the last red man has vanished from this earth, and his memory is only the shadow of a cloud moving across the prairie, these shores and forests will still hold the spirits of my people. For they love this earth as the new-born loves its mother's heartbeat. So if we sell you our land, love it as we've loved it. Care for it as we've cared for it. Hold in your mind the memory of the land as it is when you take it. And with all your strength, with all your mind, with all your heart, preserve it for your children and love it - as God loves us all.

Unit 3

Energy and Resources



CIDA Photo: Dilip Mehta, Pakistan

THEME: ENERGY

Alberta Program of Studies Curriculum Fit

Grade 8, Topic 2: **Energy and Machines**

SPECIFIC LEARNER EXPECTATIONS

Attitudes

Students will be encouraged to develop:

- respect for the diversity of approach exhibited by others in their search for solutions to practical problems
- confidence in personal ability to solve practical problems.

Concepts

- Students will identify impacts of inefficient energy use on environments and resources (eg., depletion of resources, problems in disposal of waste heat).

Grade 9, Topic 6: **Environmental Quality**

SPECIFIC LEARNER EXPECTATION

Attitudes

Students will be encouraged to develop:

- awareness of the effects that environmental quality has on the health and well-being of living things.
- awareness of impacts of human actions on environmental quality.
- respect for the perspectives and viewpoints of others.
- concern for a commitment to the maintenance of environmental quality.

Skills

Students will demonstrate the following decision-making skills:

- identifying issues and concerns regarding environmental quality.
- identifying alternatives regarding actions that may affect environments.
- reflecting and deciding
  - -considering alternatives
  - -considering perspectives
  - -building consensus

CIDA Photo: David Barbour, Tanzania

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Activity 1: Who's Got the Energy? A Simulation Game

BACKGROUND INFORMATION

In today's world we see many inequalities in the use of energy by developed countries versus less developed or developing countries.

Although we enjoy an abundance of energy here in North America, we must remember this prosperity also brings with it many environmental concerns. "The combined production, distribution, and consumption of energy is the greatest single source of stress on the environment."[1] With all the fuels that are burned, the greenhouse effect is on a continual upswing. The burning of fossil fuels also adds to the acid rain concern. "Together these emissions harm wildlife and wildlife habitat, lakes, rivers, soils, crops, materials and buildings. Human health also suffers, because SO_2 and smog can damage lung tissue and cause respiratory disease."[2]

It is not only the burning of fuels which pollutes our environment. Everyday we have some kind of spill occurring which brings about its own kind of environmental concerns. We also have a great deal of pollution in the form of solid waste which is usually left over from mining.

All of these forms of pollution are very costly not only in terms of human and animal health but also in monetary costs. "In all, the cost of environmental damage from fossil fuel use has been estimated at$100 billion per year in the United States alone."[3]

When we take a look at the energy consumption inequalities which exist in the world we should become alarmed at the 'waste' which is occurring in North America. "U.S. and Canadian consumers use nearly twice as much energy per capita as do people who live in Central Europe and seven or eight times as much as do people in developing countries."[4]

We must all make an effort today to reduce our energy consumption and must also ensure ourselves that our governments are working towards protecting the world in which we live.

1.World Resources Institute, The 1993 Information Please Environmental Almanac, Houghton Mifflin Company, 1993, p.70

2.Ibid., page 71

3.Ibid. page 71

4.Ibid. page 71

Who's Got the Energy?

Objective: To appreciate global inequalities in the use of energy

Time: 40 - 60 minutes

Participants: 1 teacher/facilitator
30 to 35 students

Materials: colour-coded cards:

North America	(10% of world population):	3 - 4
CIS/Europe	(55% of world population):	17 - 18
Western Europe	(12% of world population);	4 - 5
Rest of world	(23% of world population):	6 - 8

world maps/atlases
colour crayons
pens
sheets of paper
energy consumption "items"

North America	48
CIS/Europe	26
Western Europe	23
Rest of world	3

Procedure:

1. Students are to take a colour-coded card from a bag and sit with their group.
2. Students identify countries they are representing and colour these countries on their map of the world.
3. Teacher hands out energy consumption "items".
4. Students are to brainstorm possible uses of their energy (heating, appliances, lighting, etc.).
5. Students present their map and their brainstorm ideas, and show the other groups the number of "items" their part of the world possesses.

Questions for Discussion:

1. What was the highlight of the activity for you?
2. What aspects of the activity affected you the most?
3. What statistics were the most surprising?
4. How did you feel being in the rich or poor region of the world?
5. How would you feel about your classmates/friends if their life choices were really so much better/worse than yours?
6. What is clearer to you now about the relationship between the "rich" world and the "poor" world?
7. What can be done about this situation?

Activity Two: School Energy Audit

The School Energy Audit is designed to be undertaken by school teams of students, supervising teachers and custodians. In the evaluation afterwards, the teams should meet to tally the results and develop a remedial action plan.

Lighting

THE WAY WE USE and manage our lighting systems can directly affect the environment and our electricity bill. Check to see if your school uses the following energy conservation practices.

Does your school…	Yes	No
Conduct a conservation campaign which stresses turning off lights when they are not needed	☐	☐
Use "switch off" stickers on light switches as a reminder	☐	☐
Use natural sunlight as much as possible, discouraging the closing of blinds and drapes or the blocking off of windows with pictures and posters	☐	☐
Use "localized lighting" in individual work and study areas	☐	☐
Use a photocell control for outside security lights to cut power consumption during sunlight hours	☐	☐

Check to see if your school has done the following:

Reduced electrical consumption by replacing incandescent bulbs with fluorescent tubes, high pressure sodium or metal halide lamps in:

gymnasiums	☐	☐
corridors	☐	☐
classrooms	☐	☐
washrooms	☐	☐
offices	☐	☐
staff rooms	☐	☐
shower/locker rooms	☐	☐
Replaced 40-watt fluorescent bulbs with 34-watt fluorescent bulbs for a 12% saving on electrical energy required	☐	☐
Replaced exterior lighting with energy saving low pressure sodium lights	☐	☐
Shielded exterior lights to increase lighting efficiency and prevent light pollution	☐	☐

Building Heating System

	Yes	No
Does your school use passive solar heating systems to assist in heating the school?	☐	☐
Does your school use active solar heating systems to assist in heating of your school?	☐	☐

To heat your school, does the school use...

oil	☐	☐
natural gas	☐	☐
coal	☐	☐
wood	☐	☐
burning of waste garbage	☐	☐

THE WAY IN WHICH your school manages its heating system will probably have the largest impact on your school's energy bill. Check to see if your school...

Turns off the pilot light of the heating system during the summer holiday months	☐	☐
Uses automatic setback thermostats to reduce room temperature when the building is not occupied	☐	☐
Maintains the following thermostat temperature settings:		
Instructional areas: 20° C	☐	☐
Gymnasiums and corridors: 18° C	☐	☐
Vestibules: 15° C	☐	☐
Uses "reminder stickers" near these areas to indicate these optimum temperatures for energy conservation	☐	☐
Replaces or cleans furnace and ventilation filters each month during the heating season (dirty filters can increase consumption and thus costs by 5%)	☐	☐
Has your school planted windbreaks of evergreen trees on the north and northwest sides of the school to reduce school heating costs by 8%?	☐	☐

Water Heating and Delivery System

To heat water, does your school use...	Yes	No
oil	☐	☐
natural gas	☐	☐
coal	☐	☐
wood	☐	☐
solar energy	☐	☐

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Water Heating and Delivery System (cont'd)

	Yes	No
Is the water heater thermostat set at its lowest temperature setting? (low 50° C, medium 60° C, high 70° C)	☐	☐
Is the domestic hot water circulating pump shut down at night, on weekends and on holidays if not colder than 15° C?	☐	☐
Is the pilot light of the domestic hot water heater turned off during the summer holidays?	☐	☐
Are flow restriction shower heads installed on the showers in your school?	☐	☐
Are hot water pipes insulated to keep heated water from getting cold? If "yes" find out type of insulation and describe that type to the club/class members when you report back.	☐	☐
Is the hot water tank insulated to help prevent heat loss? (Insulation can be external or internal, more commonly internal, so check with the custodian)	☐	☐

Draftproofing and Insulation

	Yes	No
Does your school conduct awareness programs encouraging students and staff to keep doors closed during winter months?	☐	☐
Are draft detectors used to find cold air leaks around the school's... doors	☐	☐
windows	☐	☐
electrical sockets	☐	☐
Is there weatherstripping or caulking on the inside of the doors?	☐	☐
Is there weatherstripping or caulking on the inside of all windows?	☐	☐
Does the school make it a policy to check the condition of weatherstripping or caulking once a year and replace it if necessary?	☐	☐
Does the school use insulating blinds to help prevent cold air from entering the building?	☐	☐
Are insulated doors used at all entrances?	☐	☐
If your school does not use insulated doors are there double doors at all entrances?	☐	☐
Is there at least R20 insulation in the walls of the school?	☐	☐
Is there at least R40 insulation in the attic/roof of the school?	☐	☐
Is there at least R12 insulation in the basement/foundation walls of the school?	☐	☐

Transportation and Parking

	Yes	No
Is an organized car pooling system used at your school?	☐	☐
Is the use of buses and public transportation encouraged at your school?	☐	☐
Does your school encourage the use of power saver cords for car block heaters in the school parking lots?	☐	☐
Are timers used to control the use of electric outlets in the school parking lots? (15 minutes on, 15 minutes off)	☐	☐
Has your school installed an automatic thermostat switch which will cut off the power to all parking stalls with plug-ins if the temperature is warmer than -18° C?	☐	☐

Electricity

	Yes	No
Does your school obtain its electricity from the local electricity company?	☐	☐
Does your school produce some of its own electricity from:		
solar photovoltaic cells	☐	☐
wind generators	☐	☐
cogeneration (from waste heat)	☐	☐
Is a conservation campaign encouraging the wise use of electricity conducted at your school each year?	☐	☐
Refrigerators require a great deal of energy. Does your school use a cold storage room in addition to refrigerators for storing perishables?	☐	☐
Are the photocopying machines in the school equipped with an electricity saving device that cuts back on power when they are not in use?	☐	☐

Vending machines use up to $100 of electricity per year. If your school has vending machines:

How many are installed? _______________

What do the vend? _______________

	Yes	No
Do you think these vending machines are necessary?	☐	☐
Do you feel your school has too many vending machines?	☐	☐

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Background Information: Global Warming

*This information is drawn from the **Down to Earth Program**, a program designed to give students a head start in their study projects on environmental topics. Use is permitted for non-commercial purposes.*

Global warming, also known as the "Greenhouse Effect", is caused by certain gases in the atmosphere that trap the sun's heat. These gases act like the glass of a greenhouse, permitting heat from the sun to enter, but not escape.

Carbon dioxide accounts for about half of the greenhouse effect. The burning of fossil fuels (coal, oil and natural gas) causes most of the carbon dioxide emissions. Therefore, human economic activities cause global warming; driving cars, making steel, heating homes, providing electricity, etc.

The Problem

The build-up of greenhouse gases in the atmosphere is provoking a kind of global fever, with the five warmest years of the past century all falling in the past decade. Greenhouse gases, principally carbon dioxide, (CO_2), but also chlorofluorocarbons (CFCs), nitrous oxide (N_20), methane (MH_4) and low level (tropospheric) ozone (0_3) are efficient insulators that are trapping increasing amounts of the sun's radiation in the earth's atmosphere. Though the sun's radiant energy can pass through earth's atmospheric shield without hindrance, less of this energy than in the past is able to escape as heat. In the past 200 years the average annual surface air temperature of the earth has warmed by approximately 1 degree C. In the next few decades this temperature is expected to grow by another degree and possibly by as much as 4 or 5 degrees C by the second half of the 21st century.

The Consequences

In the long term, continued global warming will produce severe global climatic dislocations. Many of the earth's temperate, moist and fertile zones are likely to become barren and desert-like. Weather cycles will be disrupted everywhere, affecting the habitat and survival of much animal and plant life. Neither the mechanisms of biological adaptation, nor the patterns of migration that natural species employ, can possibly evolve rapidly enough to meet the shifting conditions of their environments.

The Solution

Despite these dire predictions, global warming can be minimized by making radical improvements in energy efficiency, by switching from fossil fuels to renewable energy sources, preventing destruction of rain forests, and by reforesting large areas. The global warming threat challenges consumers and governments to find new ways to bring them into reality.

The "developed" world has a particularly important role to play, since we are responsible for the majority of greenhouse gases. We must provide innovative solutions to other countries so that they can prosper without the negative environmental effects.

GLOBAL WARMING STUDY TOPICS

-What is the greenhouse effect?
-The sources of greenhouse gases?
-The rank importance of different greenhouse gases?
-Who contributes most to greenhouse gases?
-Are we reducing CO_2?
-Are we reducing CFCs?
-What ways can I help reduce greenhouse gases?
-The impact of global warming on Canadian water resources? Canadian farmers? Canadian forestry? Sea levels? Canadian northlands? Winter shipping? Recreation?
-What is happening in the Amazon basin?
-What's the future for populous river deltas?
-How vulnerable am I to global warming?
-Trade-offs: global warming or jobs?
-Is coal burning increasing? Where? Implications?

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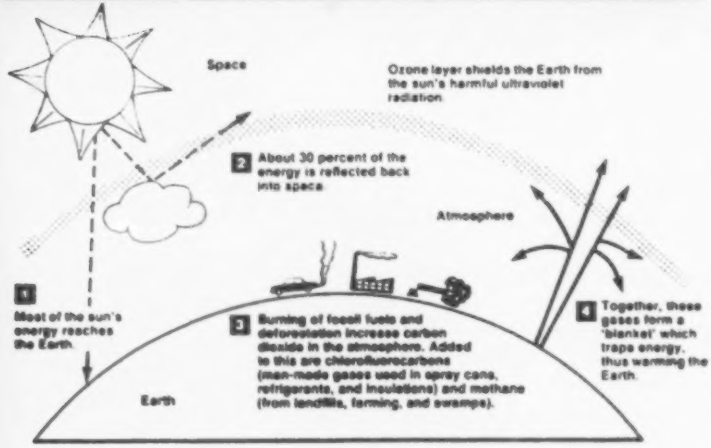
Scientists have know for nearly 100 years that certain gases in the atmosphere trap heat (infrared radiation) and keep the earth warm, much as the glass of a greenhouse keeps the air inside warm. This atmospheric blanket is in fact essential to life; without it, the earth would be some 35 degrees C colder than today and uninhabitable. A string of unusually warm years in the 1980s called attention to a new environmental threat: global warming, or the greenhouse effect.

How the 'greenhouse effect' works


Space
Ozone layer shields the Earth from the sun's harmful ultraviolet radiation
2 About 30 percent of the energy is reflected back into space
Atmosphere
1 Most of the sun's energy reaches the Earth
3 Burning of fossil fuels and deforestation increase carbon dioxide in the atmosphere. Added to this are chlorofluorocarbons (man-made gases used in spray cans, refrigerants, and insulations) and methane (from landfills, farming, and swamps).
4 Together, these gases form a 'blanket' which traps energy, thus warming the Earth.
Earth

Our atmosphere contains many gases which are transparent. Like glass, they let short wave length solar radiation pass through them. This solar radiation is absorbed by the ground, trees, buildings and even people, and in the process is changed into longer wavelengths (infrared radiation). Carbon dioxide and certain other gases with similar chemical properties absorb the energy of these wavelengths, then re-radiate it in all directions. Some is lost to space, but some is returned to the earth's surface before being eventually lost. This causes the earth's surface to be warmer than it would otherwise be.

Evidence shows the composition of our atmosphere has changed. By analyzing ancient air trapped in air bubbles deep in Antarctic ice, studies show that the concentration of CO_2 has increased by 25% since 1800 and global temperatures have increased over the past 150 years. Most scientists now accept that global warming is a reality and that it is primarily related to increasing concentrations of greenhouse gases.

Greenhouse Gases

Carbon Dioxide is a naturally occurring gas; it is released by all animals when they exhale. Burning of fossil fuels (oil, coal and natural gas) release large amounts of extra man-made carbon dioxide into the atmosphere.

Carbon dioxide is considerably less efficient at trapping heat than other greenhouse gases; the combined effect of these other gases would approximately double the effect of CO_2.

Methane (CH_4) is most familiar as a major component of natural gas used in cooking. Molecule for molecule, methane traps 25 times more of the sun's radiation in the atmosphere than CO_2. The major sources of atmospheric CH_4 are ruminant animals (eg., cattle, 30% of Canadian methane emissions); biomass burning (burning forest and grassland); land fills (50% of Canadian methane emissions), and gas and coal fields.

Nitrous Oxide (N_2O): there has been an increase mainly due to the combustion of fossil fuels and biomass burning.

Chlorofluorocarbons (CFCs): Molecule for molecule CFCs are approximately 10,000 times more effective at trapping heat than CO_2. CFCs are used in air conditioning, insulation foams, some medical aerosols and as solvents.

Ozone (O_3) is a natural component of the atmosphere as well as being caused by a chemical reaction between car exhaust and sunlight know as photochemical smog. Ozone is particularly effective at trapping heat.

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Effects

Rising temperatures will bring a number of changes in the environment, some more difficult to predict than others. One almost certain change is that the oceans will rise because warmer water will expand and Arctic ice sheets and alpine glaciers will partially melt. Studies suggest that the sea-level rise will be between 30 cm and one metre by the mid-21st century, enough to hasten shore erosion, destroy irreplaceable wetlands, and contaminate water supplies and drainage systems with seawater; and flood low-lying coastal areas. In developing countries like Bangladesh and Egypt that are heavily dependent on food grown in low-lying river deltas, the rising seas could cut food production and force migrations to higher ground.

Major changes in weather patterns are also expected. Overall, average precipitation around the world will rise - but not necessarily where and when it is most needed. Much of the moisture evaporating from the oceans will be carried to northern regions, where it will fall as winter snow. In the interiors of the continents, the weather may actually become drier in the summer, causing more frequent droughts. As the oceans warm, the severity and frequency of tropical storms and hurricanes could increase. The impact on forests and wildlife could be the most severe. Many species could die because they could not migrate north quickly enough or because their avenues of escape would be blocked by urban sprawl.

One further source of concern is the West Antarctic Ice Sheet, an enormous expanse of ice that sits on the land below sea level. Some studies have suggested that the sheet is unstable and could disintegrate if the waters around Antarctica warmed slightly resulting in a further rise in sea levels.

What Can Be Done

1. *Halt the worldwide destruction of forests.* When trees are cut and burned they release carbon dioxide, methane and nitrous oxide. Forests especially in tropical regions are being destroyed at the phenomenal rate of about an acre a second. This has a doubly devastating effect on global warming because trees absorb carbon dioxide. So not only is cutting and burning producing greenhouse gases, it is forever eliminating the forests' ability to absorb the same gases.

2. *Reduce the worldwide consumption of fossil fuels.* The burning of fossil fuels (mostly coal, oil and natural gas) releases at least 70% of total human carbon emissions. It is also a major source of nitrous oxide, methane, and ground-level ozone (a component of smog). We must increase our efforts to use energy more efficiently.

2. *Replace fossil fuels with other renewable sources of energy.* Even with improved efficiency, new sources of energy that do not produce greenhouse gases will eventually be needed to replace fossil fuels. Several types of renewable technologies have made remarkable progress over the past decade, including solar energy, wind power and geothermal power.

One disadvantage renewable sources must contend with is that fossil fuels are, in effect, subsidized, in that a number of economic, environmental, and social costs are not included in their price. Figuring in such hidden, but real, costs could more than double the price of electricity produced from coal plants, making renewable electricity sources far more competitive.

Two other electrical power sources need mentioning:

i) *Hydroelectric power* where available is quite inexpensive. However, much of

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Canada's theoretical hydroelectric potential has already been exploited and much of the rest may be difficult to tap without further costly damage to the environment. Large scale dam projects in developing countries often displace entire communities and likewise do environmental damage.

ii) *Nuclear power* does not produce greenhouse gases. For at least the next decade, however, nuclear's potential will be limited. Chronic problems of safety, cost, management, and disposal of radioactive wastes have not yet been resolved, satisfactorily.

4. *Worldwide elimination of CFCs:* Long-lasting manufactured chemicals that are used in refrigerators, air conditioners, insulating foams, medical aerosols and as solvents.

What Can You Do?

There is a dramatic global imbalance between the consumption levels of industrialized nations and those of developing countries. Currently the industrial world nations consume about 85% of the earth's non-renewable resources. On average, per capita emissions of carbon dioxide emissions are about 7 times as high in the industrialized world as they are in the developing nations.

Canada has one of the highest per capita ratios of energy consumption and carbon dioxide emissions of any country in the world. If the rest of the world had the same levels of gas emissions per capita as Canada, the world would most certainly be unliveable. As a consumer, you are in a position to help reduce greenhouse gases and global warming. Here are two suggestions:

i) *Lifestyle Changes:* Reduce, reuse, recycle, rethink.

ii) *Plant, Plant, Plant and Compost*

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Activity Three: Global Warming Experiment

This activity is drawn from Green Teacher Magazine, Volume 32, page 23.

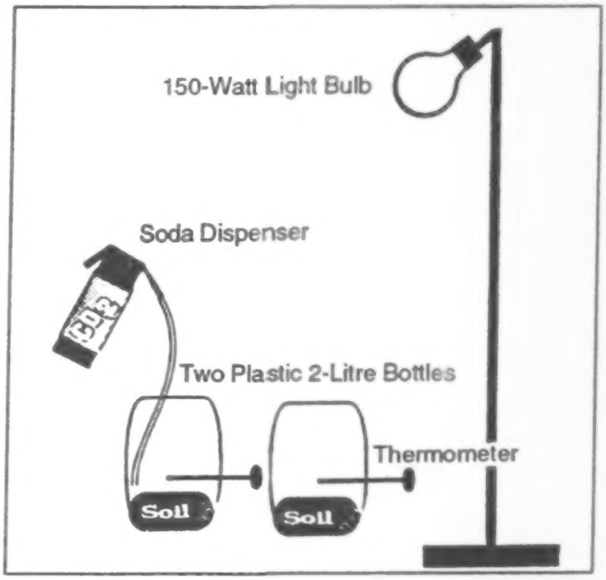
Carbon Dioxide and the Greenhouse Effect (Too Much Of A Good Thing)

Purpose: To determine the effect of increased carbon levels in the environment.

Materials: Two plastic 2 litre pop bottles, dark dry soil, two thermometers, one 150 watt or brighter spot light bulb, light stand, pressurized soda dispenser and a 25 cm. hose that fits on dispenser funnel, two soda cartridges (CO_2 cartridges)

Method:

1. Cut the tops off of the plastic bottles.
2. Place 5 cm. of potting soil in each bottle.
3. Cut a small hole to insert the thermometer, 5 cm. above the soil in the side of the bottle.
4. Place the thermometer through the hole so that the end of the thermometer is in the middle of the bottle.
5. Place bottles equal distance and orientation from the light, approximately 25 cm.
6. Discharge one CO_2 cartridge into the soda dispenser. CO_2 is heavier than air so it will stay in the bottle for the duration of the experiment.
7. Place the soda bottle hose 2.5 cm. from the soil in one bottle and slowly release the CO_2 into the plastic bottle. Repeat steps 6 and 7 so that two CO_2 cartridges have been discharged into one bottle. Leave the other plastic bottle with normal air, as the control.
8. Record the temperature in each bottle.



9. Turn on the light. Observe and record the temperature every minute for 10 minutes (Do not let the experiment exceed 10 minutes, as the CO_2 will have dissipated after this time).

Option: Test for the presence of CO_2 by lowering a burning match or splint into each bottle, immediately after adding the CO_2 and then again at the end of the experiment.

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Activity Four: Renewable vs Non-Renewable Resources

BACKGROUND INFORMATION

To assist the teacher with this lesson it is recommended that the teacher/facilitator read the enclosed information from TransAlta Utilities (*From Coal to Kilowatts*) and from The Coal Association of Canada (*Alberta's Sub-Bituminous Coal)*. The full texts can be obtained from your local TransAlta Utilities office and from the Coal Association of Canada, 502, 250 - 9th Av. S.E., Calgary, AB T2G 0R3.

Alberta Program of Studies Curriculum Fit

Grade 7, Topic 4: **Temperature and Heat Measurement**

Grade 8, Topic 2: **Energy and Machines**

Grade 9, Topic 3: **Heat Energy: Transfer and Conservation**

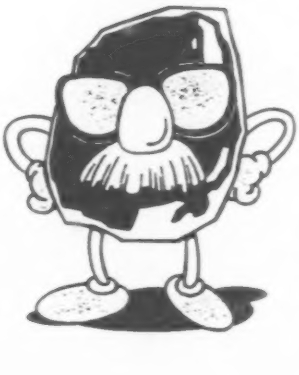
A PIECE OF IS A PIECE OF

At first, all coal looks pretty much the same. But it's not. There are some important differences. There are 2 basic uses for coal — thermal and metallurgical.

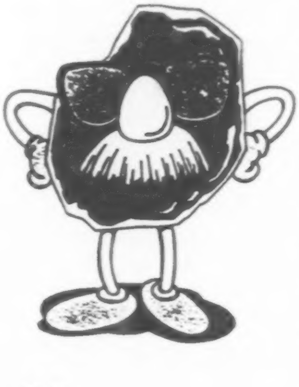
We often divide coal into different types. Only 2 types, sub-bituminous and bituminous, are found in Alberta.

- **Lignite** (LIG-night) is the softest coal. It contains the most moisture (water). It can be brown or black. Lignite is the lowest grade of coal. It produces the least amount of heat when it's burned.

- **Sub-bituminous** (SUB-bih-TOO-mih-nuss) is a bit harder. It has less moisture than lignite and it burns hotter. It's used for making electricity. TransAlta uses this type of coal.

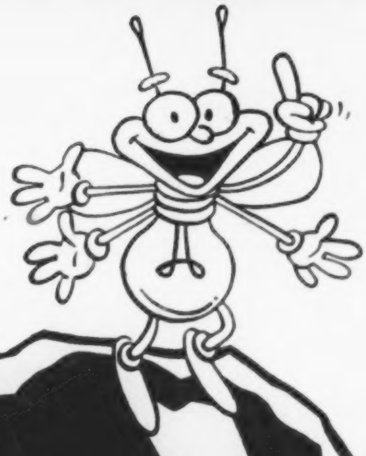


- **Bituminous** (bih-TOO-mih-nuss) is harder than the first two kinds of coal. It has less moisture as well. Bituminous coal is used in making steel and electricity.



- **Anthracite** (AN-thra-SIGHT) is the hardest, blackest, shiniest coal. It has very little moisture in it. It's the most valuable coal because it produces the most heat when it burns. In other countries, anthracite coal is used for cooking in homes.

WHY DO WE USE COAL?



There are several reasons why we use coal to make electricity.

- **Alberta has a large supply of coal.** About 80% of all the coal that has been found in Canada is here in Alberta. TransAlta owns enough coal to make electricity for the next 30 years.

- **The coal is mainly sub-bituminous.** This soft coal doesn't have many uses except for producing electricity.

- **The coal is easy to mine.** Most of the coal that TransAlta uses lies close to the surface of the ground. It's easier to mine than coal that lies underground.

- **The mined area can be used again.** After the coal has been removed, the holes are filled in and the soil is put back. The land can then be used for farming, for wildlife, or for recreation.

- **The coal doesn't cost a lot.** TransAlta began buying coal deposits more than 30 years ago when both land and coal were cheaper.

- **Alberta's coal doesn't have much sulphur in it.** In eastern North America, coal often contains a lot of sulphur. When this coal is burned, it sends the sulphur into the air. The sulphur compounds mix with water to form acid rain. When acid rain falls to the ground, it harms the environment as well as the plants and animals that live there. TransAlta's low-sulphur coal causes less of a problem.

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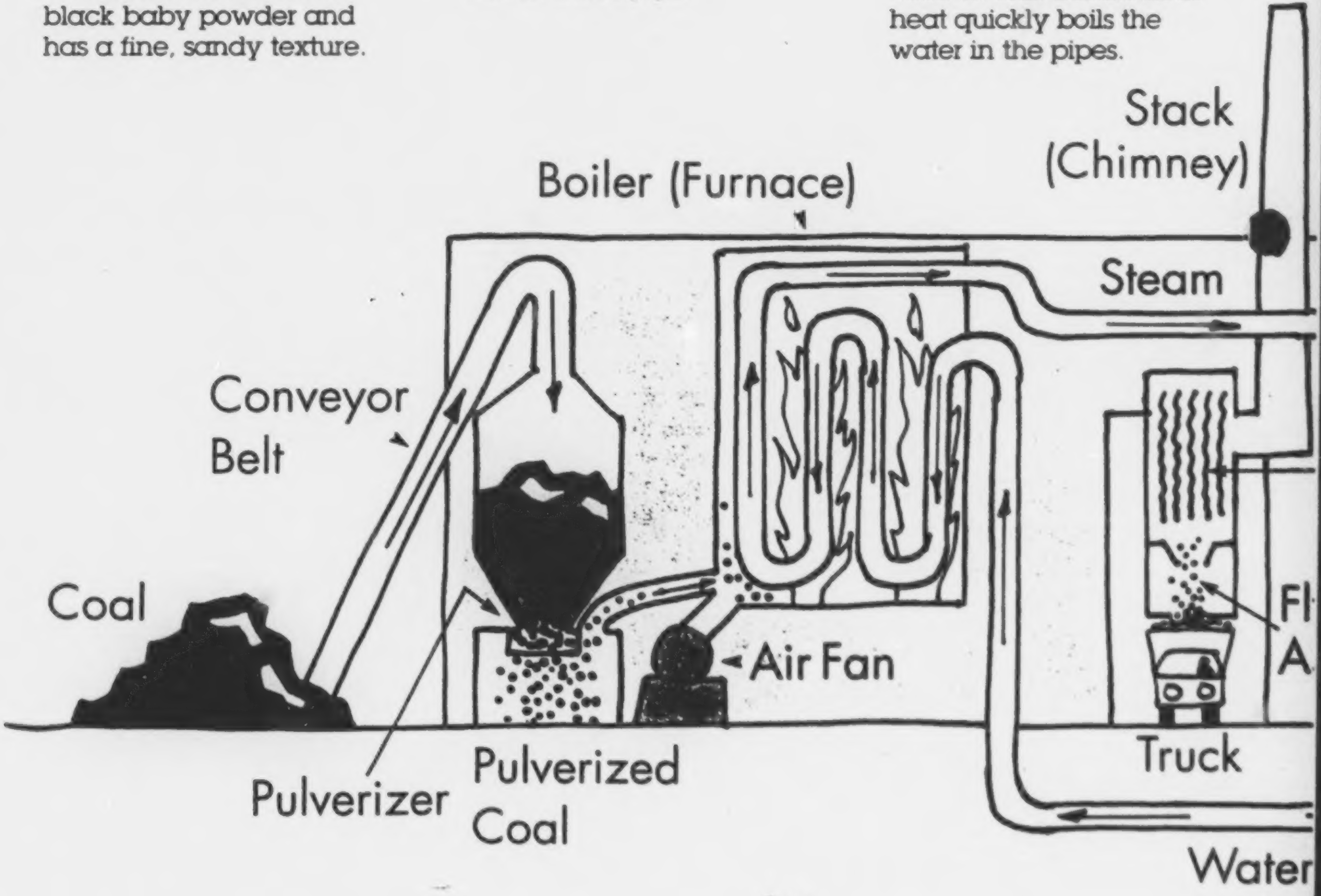
MAKING ELECTRICITY:

Have you ever tried to burn a rock or set a stone on fire? It just doesn't work. Unless that rock happens to be coal. Let's go inside the generating plant and find out what happens next.

1 A conveyor belt carries the crushed coal into the plant. Here, in the pulverizer, the coal is crushed even smaller. It now looks and feels like black baby powder and has a fine, sandy texture.

2 Hot air from nearby fans blows the powdered coal into a gigantic furnace. The furnace walls are lined with many kilometres of water pipe.

3 The furnace is very hot. The powdered coal mixed with air instantly catches fire. Temperatures inside the furnace may reach 1300°C. This tremendous heat quickly boils the water in the pipes.



THE GENIE IN THE GENERATOR

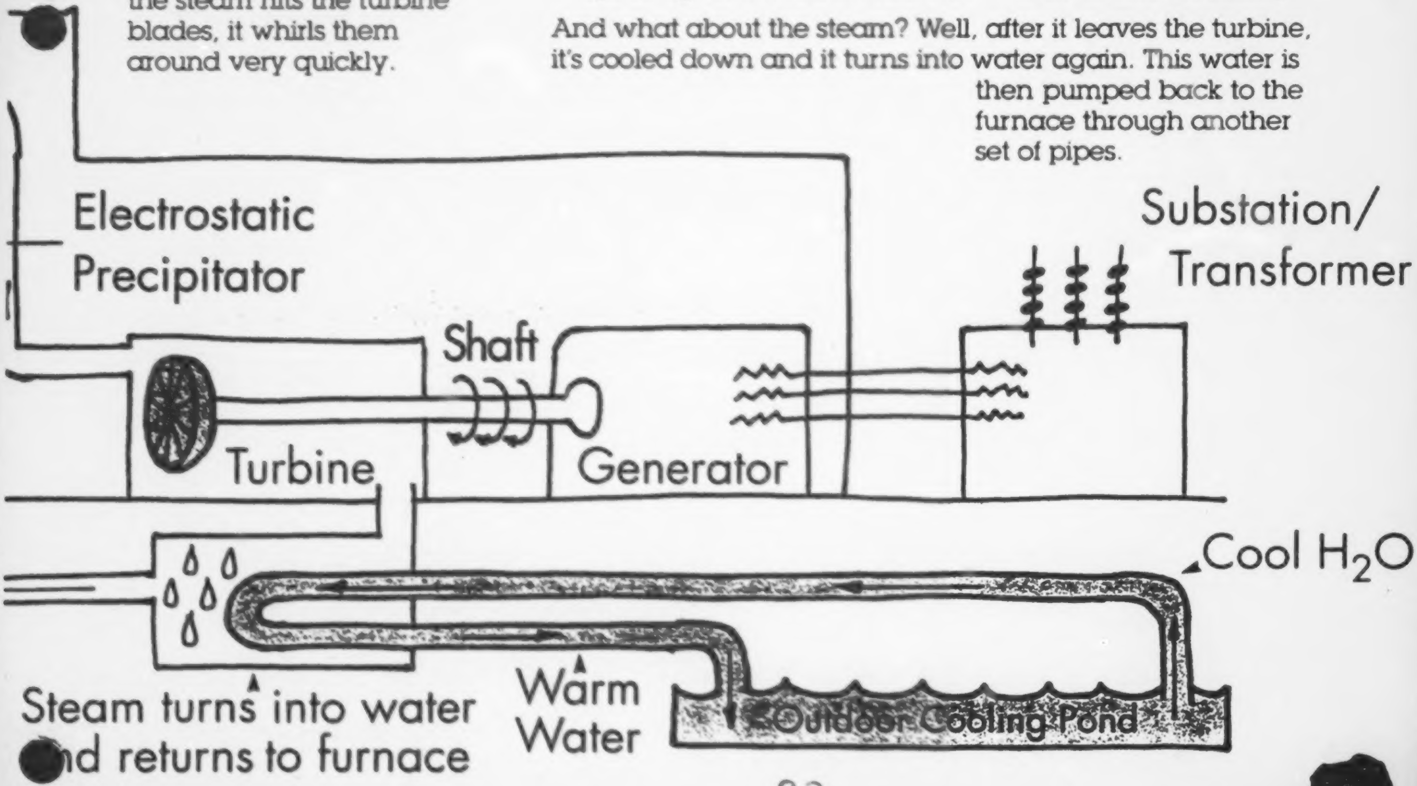
4 The boiling water turns to steam, just like water in a kettle.

5 The steam flows through pipes into a large machine, the turbine. The turbine looks like a giant fan with hundreds of blades. When the steam hits the turbine blades, it whirls them around very quickly.

6 A metal rod, the shaft, connects the turbine to the generator. The steam turns the turbine blades... which turn the shaft... which turns the generator.

Remember the Genie and the magic lamp we talked about earlier? Well, if there were an electrical Genie, this is where it would live — in the generator. It's the whirling generator — spinning 3,600 times a minute — that makes electricity.

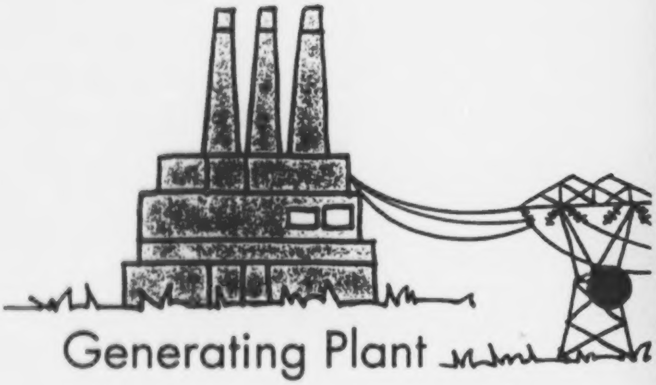
And what about the steam? Well, after it leaves the turbine, it's cooled down and it turns into water again. This water is then pumped back to the furnace through another set of pipes.



TRANSMISSION: FROM US

Now that we've made the electricity, how does it get from our place to yours?

At the generating plant, special equipment (called transformers) increases the voltage in the lines. These transmission lines carry the electricity to many parts of Alberta. Perhaps you've seen our transmission towers as you've travelled around the province.



Near large population centres, you'll find substations. The equipment here reduces the voltage flowing into the distribution lines. The distribution lines carry electricity to the customers.

Although this may sound like a long trip, it happens in less than a blink of an eye. Electricity travels at the speed of light — about 299,800 kilometres a second.

In some neighbourhoods, electric lines are buried underground. In other areas, the lines are above ground.

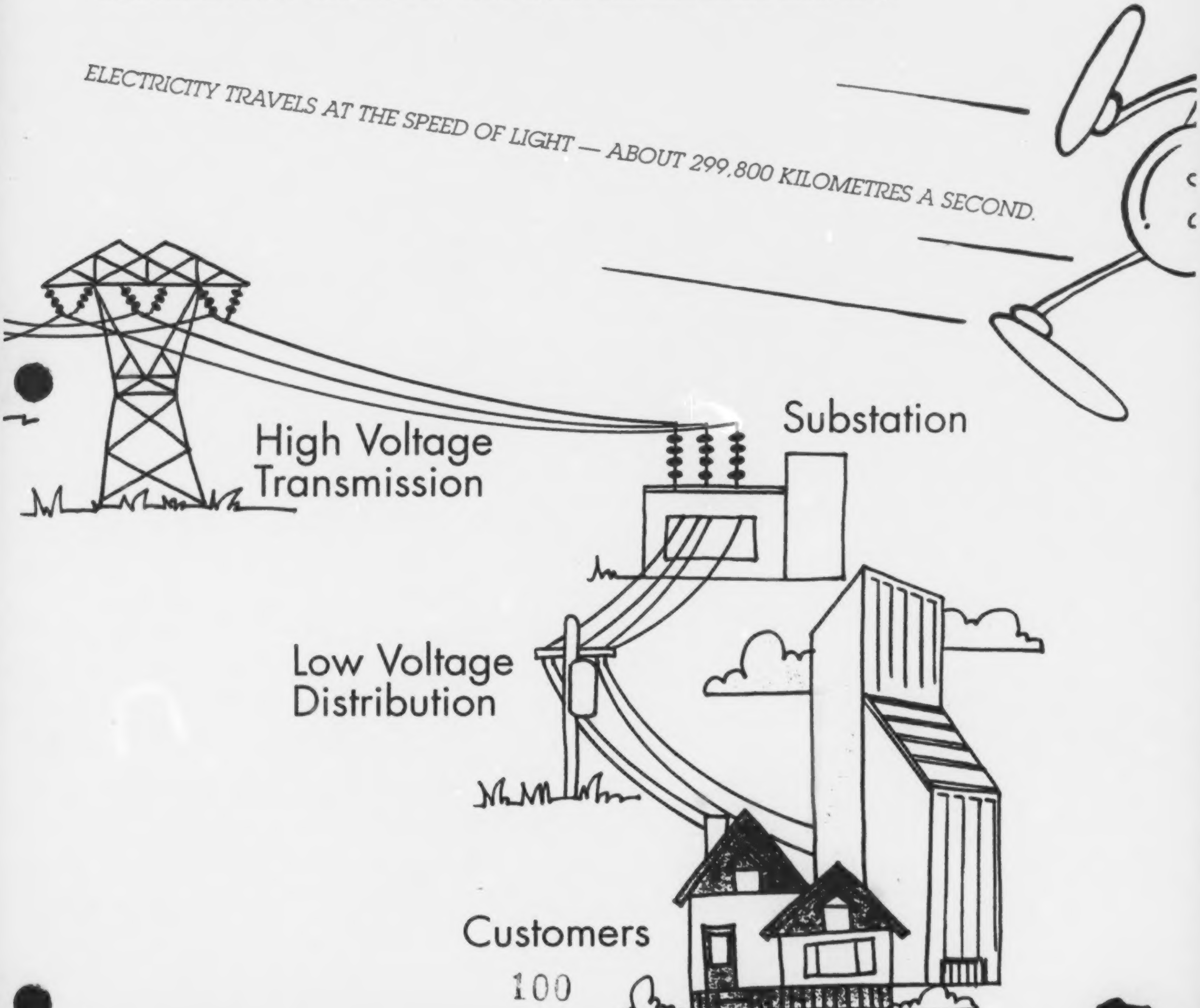
Lines above the ground are carried on tall poles. If you look near the top of some poles, you'll see a metal container that looks a bit like a garbage can. This is a transformer. These transformers reduce the voltage in the distribution lines going to customers homes.

Inside or near each building or house, you'll also find an electric meter. It measures how much electricity each customer uses. We measure electricity in kilowatt-hours (kWh). By reading your meter, we know how much to charge you for the electricity you've used.

TO YOU

TransAlta isn't the only company in Alberta that makes electricity, but we are the biggest. We supply about 77% of all the electricity in the province. Alberta Power, Edmonton Power and the City of Medicine Hat also make electricity.

ELECTRICITY TRAVELS AT THE SPEED OF LIGHT — ABOUT 299,800 KILOMETRES A SECOND.



THE ENVIRONMENT:

THE LAND

When Humpty Dumpty fell off the wall, not even all the King's horses and all the King's men could put Humpty Dumpty together again. Is that what happens at the coal mines? Has the land been destroyed? Can the mined area ever be used again?

Long ago, many coal mining companies didn't worry about such questions. There was a lot of empty space in this country. They didn't see a need to repair the damage they did to the land.

Today, we do things differently. We care about the land. We make sure to repair the damage we did when we took out the coal. In fact, TransAlta began to reclaim its land 12 years before the provincial government made companies reclaim mined land.

We call these repairs reclamation (WRECK-la-may-tion). This means we fill in the holes and put back the soil that we scraped off. Then we plant seeds. Within a few years, the land produces crops we can harvest. Sometimes, instead of planting crops, we turn the land back to the wildlife.

AIR

Does burning coal cause air pollution? Yes, it can. And we work very hard to keep this from happening.

When coal is burned, it produces two kinds of ash — bottom ash and fly ash.

Tonnes of bottom ash fall to the bottom of the furnace every hour.

There are 2 ways to get rid of ash. It can be moved through water pipes or by trucks. It lands in a trough of water to cool off and is carried out of the plant. Bottom ash is greyish brown in colour. Once the water evaporates, the ash becomes hard and rock-like. It looks a bit like porridge with holes in it.

Trucks can also carry the bottom ash out to the mine site. The ash is dumped into the holes to replace the coal that was taken out.

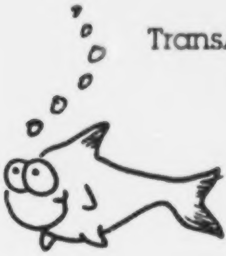
Fly ash is very light. It looks and feels like grey baby powder. It flies up the huge chimney (the stack) along with gases from the burning coal. If we let all the fly ash go up the chimney, it would produce a lot of pollution. So we try to capture most of the fly ash before that happens.

To do this, we use a machine that works much like a huge air filter. It's called an electrostatic precipitator — and it's about the size of a large apartment building. It removes more than 99% of the fly ash.

Most of the fly ash is taken to the mine site and dumped in the pits along with the bottom ash. Some fly ash is used to make cement and concrete. Other uses may be found for fly ash in the future.

Acid rain can be another form of pollution. Burning coal that contains a lot of sulphur causes acid rain. As we explained earlier ("Why Do We Use Coal?"), we burn coal that contains very little sulphur so it causes less of a problem.

THE WATER



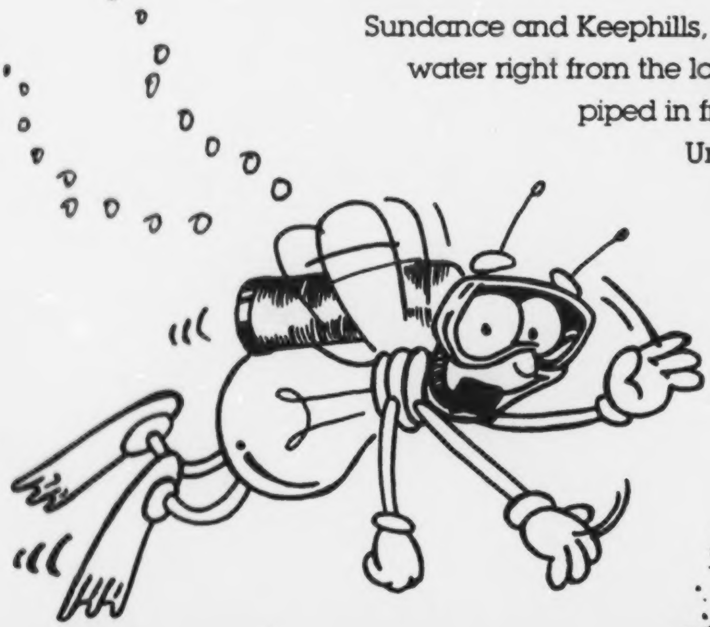
TransAlta runs 3 generating plants in the Wabamun Lake area. We use a lot of water to produce steam. We also use water to cool the steam down so it becomes water again. Does this cause water pollution?

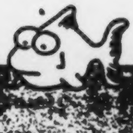
The water in the furnace pipes forms a closed system. This means the water does not go into the lake. It remains locked inside the system of pipes. It goes from water to steam and back to water again — all inside the same pipes. It can't get into the lake, but it is such a small amount that it wouldn't cause any problems anyway.

But what about the other water used to cool down the steam in the pipes? That water is also inside a set of pipes — a different set from the first one.

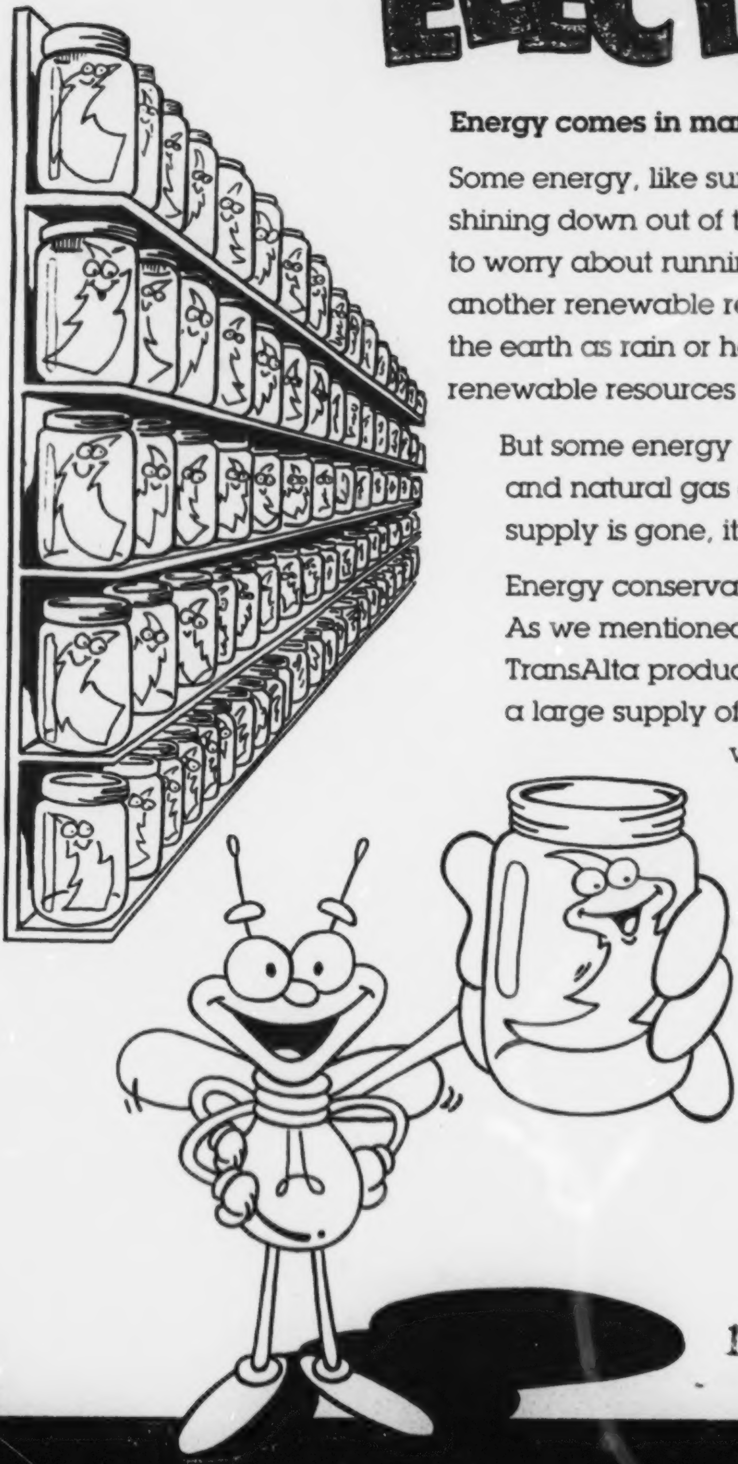
Wabamun, the oldest plant, uses water right out of the lake in its cooling pipes. This means that it does put warm water back into the lake.

Sundance and Keephills, the other two plants, do not use water right from the lake. Instead these plants use water piped in from the North Saskatchewan River. Unlike the Wabamun plant, these two plants don't put warm water into the lake. Instead, we built special cooling ponds alongside the lake. Warm water from the plant is put into these ponds to cool down before we use it again.





SAVING ELECTRICITY



Energy comes in many forms.

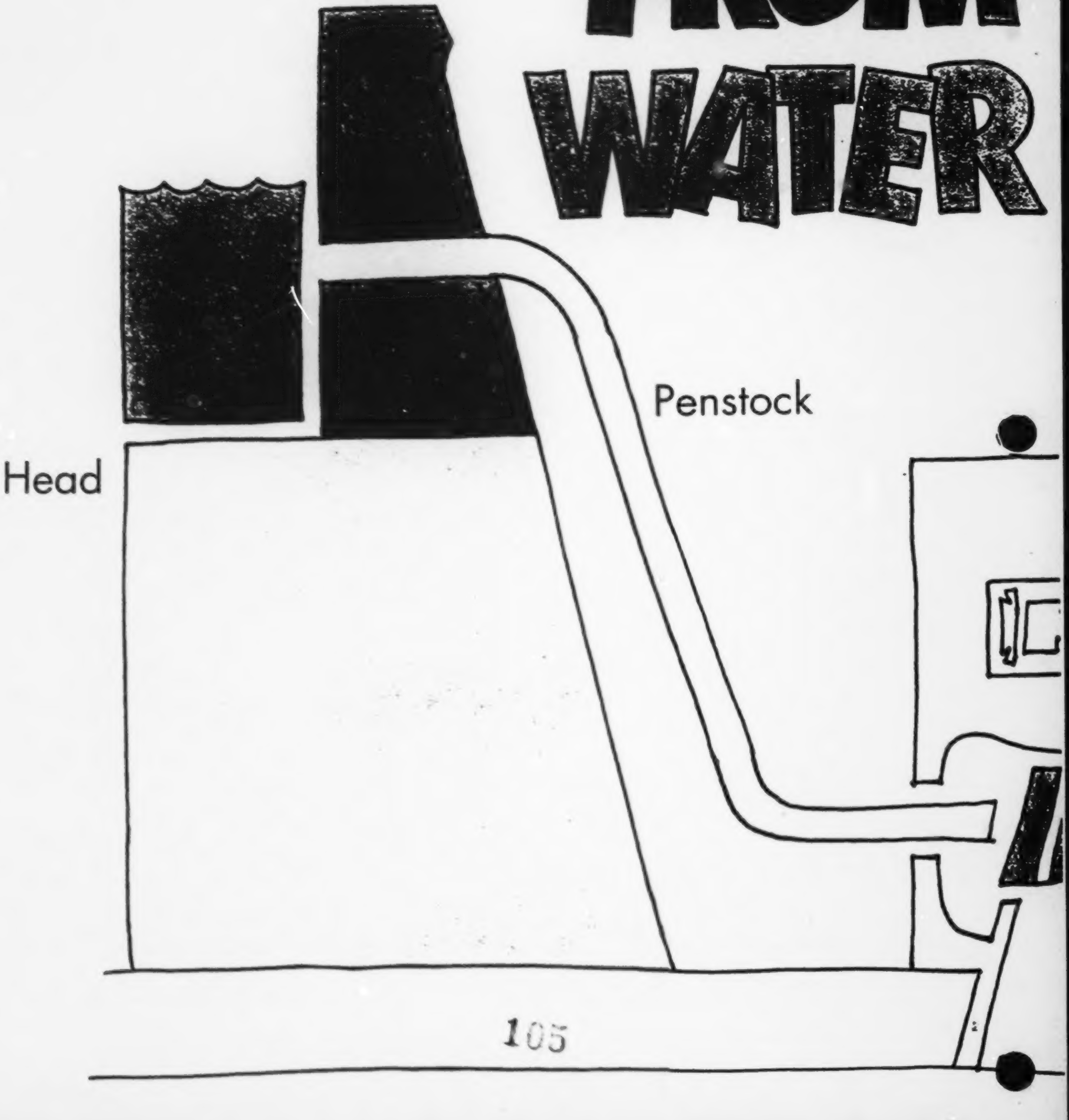
Some energy, like sunlight, is renewable. It comes shining down out of the sky every day. We don't have to worry about running out of sunshine. Water is another renewable resource. It's constantly falling on the earth as rain or hail or snow. We can use these renewable resources over and over again.

But some energy can only be used once. Coal, oil and natural gas are nonrenewable. When the supply is gone, it's gone forever.

Energy conservation means using energy wisely. As we mentioned earlier, 90% of the electricity that TransAlta produces comes from coal. We do have a large supply of coal — but that doesn't mean we can waste it.

We all use electricity. Few of us would want to live in a world without it. Perhaps you can think of ways to save electricity. If we use it wisely, there will be enough for everyone.

ELECTRICITY FROM WATER



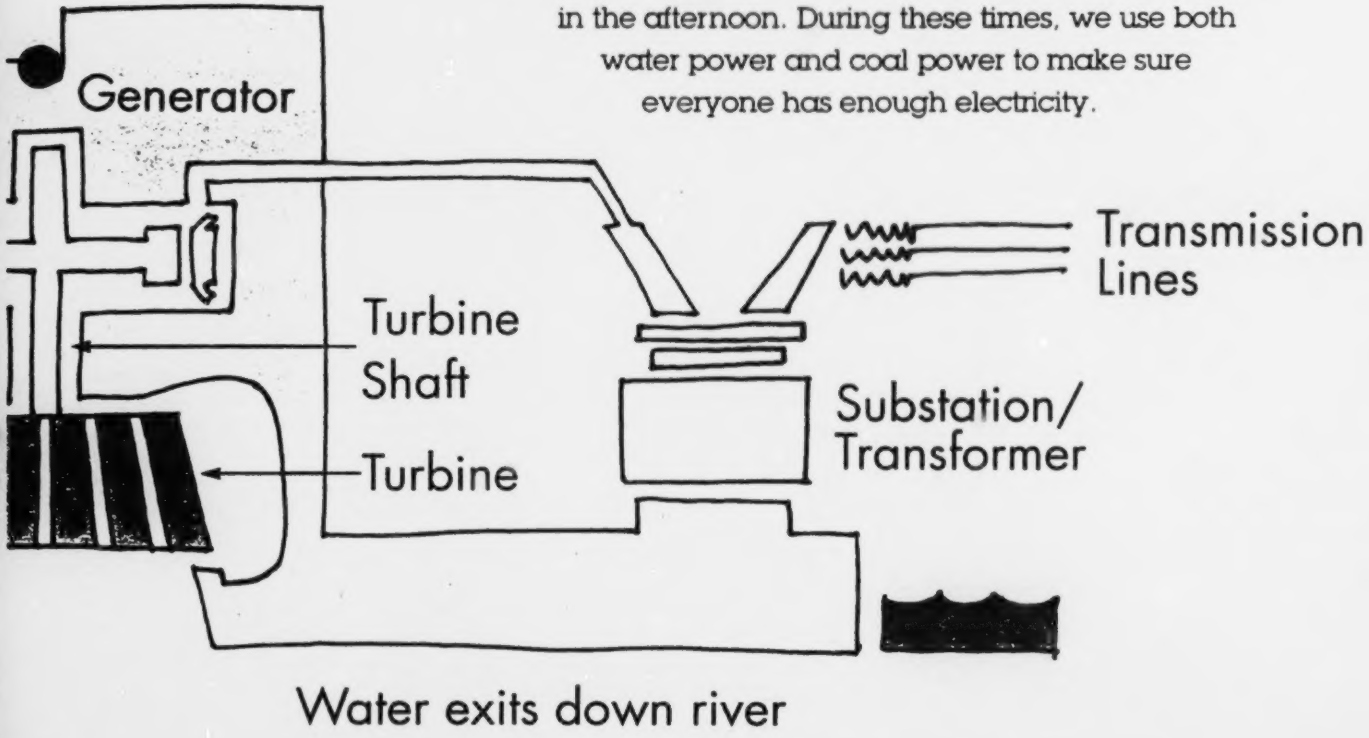
At the beginning of this story, we said that 90% of the electricity produced by TransAlta comes from coal. The other 10% comes from water power. It's often called hydroelectric power.

When we first started making electricity in 1911, we used water. (We were called Calgary Power back then.) We built our first dam, Horseshoe Dam, on the Bow River west of Calgary.

Today we operate 13 dams. Eleven are on the Bow River system between Banff and Calgary. The other 2 are on the North Saskatchewan River system.

Remember how the coal was burned to turn water into steam? That steam then turned the blades on the turbine. With hydro power, we don't use steam, we use flowing water instead. The water flows down a large pipe called a penstock. (The "head" is the distance the water falls.) The falling water turns the blades on the turbine which turns the shaft and generator. The rapidly turning generator produces electricity.

At certain times of the day, the peak periods, people use a lot of extra electricity. These peak periods usually occur between 6 and 8 in the morning and between 5 and 7 in the afternoon. During these times, we use both water power and coal power to make sure everyone has enough electricity.

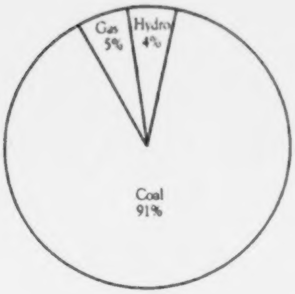


Alberta coal: a significant industry

◆ Today in Alberta there are seven highly efficient coal mines producing over 23-million tonnes of low-sulphur coal every year. This coal is burned as fuel in seven large thermal-electric generating stations to produce over 90 per cent of Alberta's electricity. The province's abundant and economic coal reserves have allowed Albertans to benefit from some of the lowest-cost electricity in the world, and this efficient energy has been a key contributor to Alberta's economic growth and prosperity.

Electricity generation by fuel type - 1993

in percentage of electricity produced



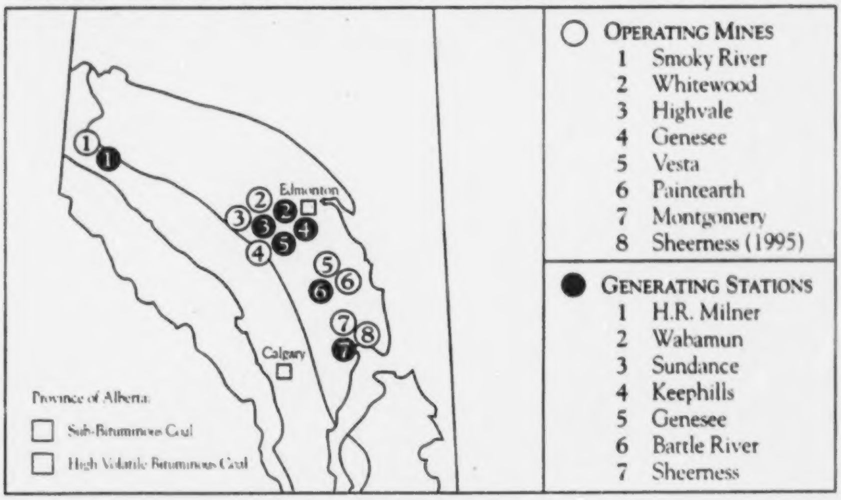
Source: Energy Alberta 1993, ERCB 94-40

An additional five Alberta coal mines produce bituminous coal for domestic use and export. Alberta coal is shipped to Ontario for power generation, and to steel mills and power plants in Japan, Korea, Brazil and elsewhere.

Alberta's coal industry generates over $500 million in revenues annually. It provides stable, direct employment to 2,500 Albertans, and is recognized as a world leader in land reclamation and environmental management. Alberta's high-quality coal reserves will last for the next 900 years at current rates of production, offering a secure, long-term fuel choice to reliably promote sustained economic growth in Alberta.

In 1973, the Government of Alberta established sub-bituminous coal as the province's preferred fuel source for base-load electrical power generation. That decision made by Cabinet and the Energy Resources Conservation Board (ERCB) over two decades ago has proven to be a wise one, and coal continues to make sense for Albertans today.

ALBERTA'S COAL REGIONS AND SUB-BITUMINOUS MINE LOCATIONS



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Renewable vs Non-Renewable Resources

Objective:	To realize that there are both positive and negative effects when natural resources are used.
Time:	40 to 80 minutes
Materials:	Student handout with overhead sheet Overhead sheet of coal/gas use Extension Activities

Procedure:

1. Define renewable and non-renewable resources.
2. Review and discuss overhead of "World Fuel Reserves"
3. Have students complete the handout on possible effects of resource use.
4. Put answers on overhead and discuss.
5. Have students complete the extension activities

Crossover to other subject areas:

Language Arts:	debate use of renewable vs non-renewable resources
Social Studies:	personal response essay (eg., Should we be forced to use our surrounding renewable resources before using non-renewable resources?)

Extension Activities:

1. The student could do a research paper on the use of solar energy and how effective it is in homes (see pages 112 and 113, drawn from ***A Piece of Sunshine***, provided by TransAlta Utilities. Teachers may photocopy from this guide).

2. Make a comparison between wind and water energy. How is energy transformed from these two resources?

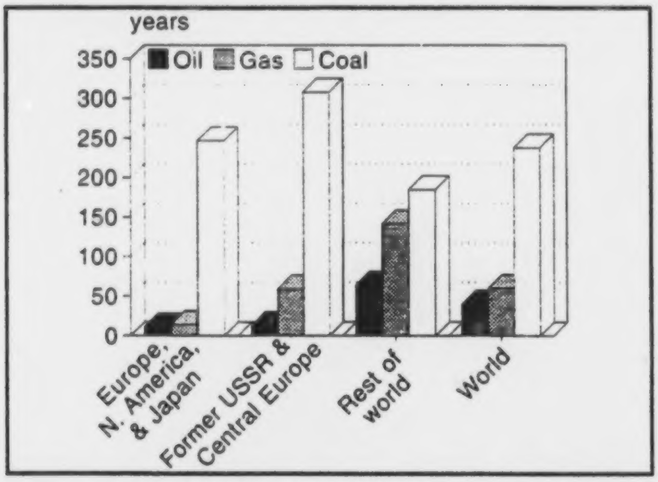
3. What kinds of coal do we find in the world and how is it transformed into energy that we receive in our homes (see ***From Coal to Kilowatts***, above, from TransAlta Utilities)?

Overhead

World Fuel Reserves

Energy consumption is always on an increase whether this is consumption of oil, gas or coal. As you can see in the chart below, we still have many coal resources left at our disposal. However, it may not be wise to start looking at coal as a substitute for other forms of energy. We know that burning any fossil fuel emits carbon dioxide which is the major factor contributing to the greenhouse effect.

World Fuel Reserves
(projected reserve to production ratio, 1991)



Source: *BP Statistical Review of World Energy* (British Petroleum, London, June 1992), p. 36.

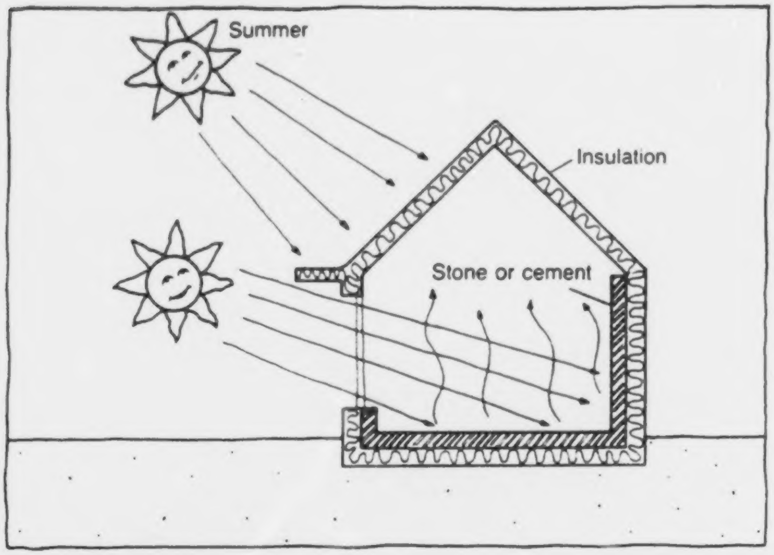
Source: World Resources Institute, ***The 1993 Information Please Environmental Almanac***, Houghton Mifflin Company, 1993, p. 72

Student Handout

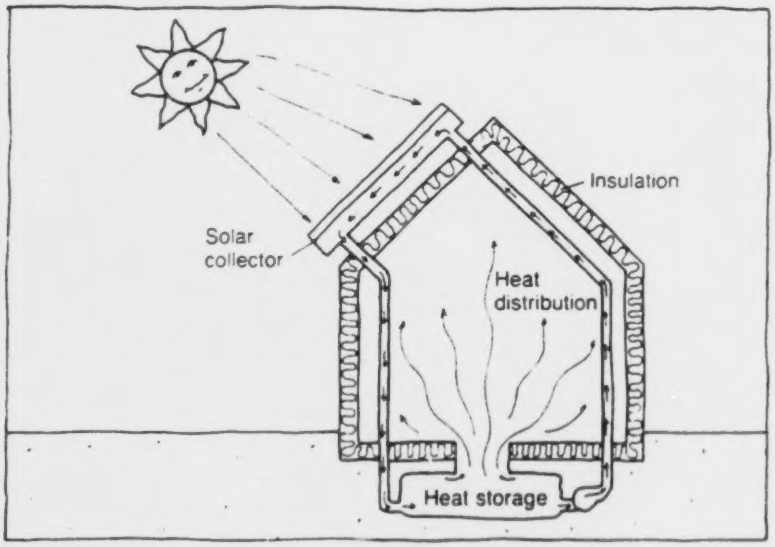
POSSIBLE EFFECTS OF RESOURCE USE

Resource	Use	Positive	Negative
Coal			
Gas			
Oil			
Wood			
Solar			
Wind			
Water			

Solar Energy

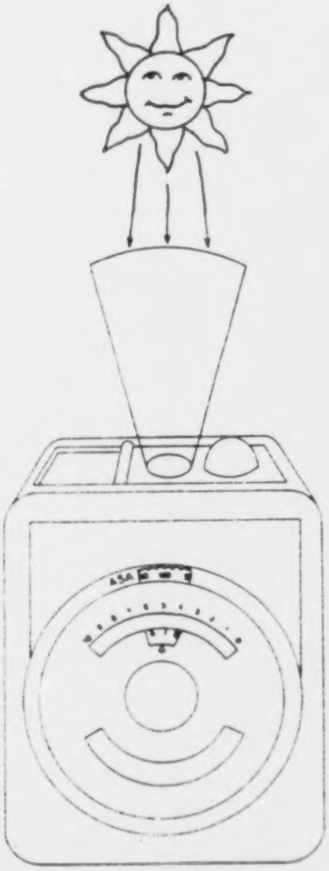


Passive Solar Heat: On sunny days, we all have noticed how warm a closed car gets compared to the outside temperature. This "greenhouse effect" is used to grow plants in winter. Trapped sunlight can also heat our homes.



Active Solar Heat: Unfortunately, when we most need heat, the sun does not shine. At night, energy stored in water tanks or rocks can be circulated through the house.

Solar Cells



Radiant energy from the sun can also produce electricity. In the film, Timmins the Beaver used solar cells to energize her circuits. Today, solar cells can be used as light meters on cameras, or as rechargers for devices such as watches or calculators. The costs are great but will improve. Since 1970, solar cell costs have dropped by 98%. In the future, satellites could use solar cells to produce electricity out in space before the sunlight is reflected away from our atmosphere. This energy can be beamed to earth as microwaves (radiant energy), as depicted in the film.

Activities

Biomass & Biofuels

We still do not make the best use of our world's resources. Up until now, it has been regarded as too expensive or unnecessary to utilize "unconventional" sources. However, in the future, much of our garbage can be burned to produce electricity, as can by-product wastes from the wood industry. Many plants can be used to produce gases or liquids that can be burned. These biofuels may replace gas and oil, especially in transportation. To make maximum use of wastes, our society will require extensive redesigning.

1 Have the students create an "imagimobile" using different media. Models or pictures may result from the activity.

2 In their "imagimobile" have the students go on an energy search into the past and write a story about their journey.

3 Have the children tell about and list the energy they use when they are having fun.

4 In a class discussion define pollution. Have the children state examples of pollution shown in the film and also in their surroundings.

5 Divide the class into four groups. Each group would depict, in a mural, one of the time frames from the film (caveman, pioneer, present and future).

6 Timmins is a solar powered beaver. Have the children discuss which source of energy they would use to power an animal of their choice.

7 Have individuals or groups choose a particular item such as roller skates or bicycles, and discuss what different forms of energy were used in the production of the item.

8 Have the children pretend they are cavemen and tell about the wonders of energy they see in today's society.

9 Have the students discover ways in which steam engines are used as a source of power.

10 After a discussion of the uses of the sun's energy shown in the film, have the class predict new ways of using the sun.

11 Using a large carton (e.g. refrigerator box) have the class construct a time machine. The children could dial back to the past and describe or act out what they "see".

12 Have the students use reference material and trace the development of community life in early Canada to show the different ways energy was used.

13 Have the students do a comparison between how pioneers obtained their food and how we obtain our food.

14 Have the children start a scrapbook for future use, using newspaper clippings and magazine articles.

15 Have each child make a list of the machines he/she uses in a day. For each, they must determine the form of energy used. The class, as a group, can make a large graph which would reveal the energy "slaves" they have in common.

16 Turning lights off conserves energy. Have the children design posters to show other ways of conserving energy.

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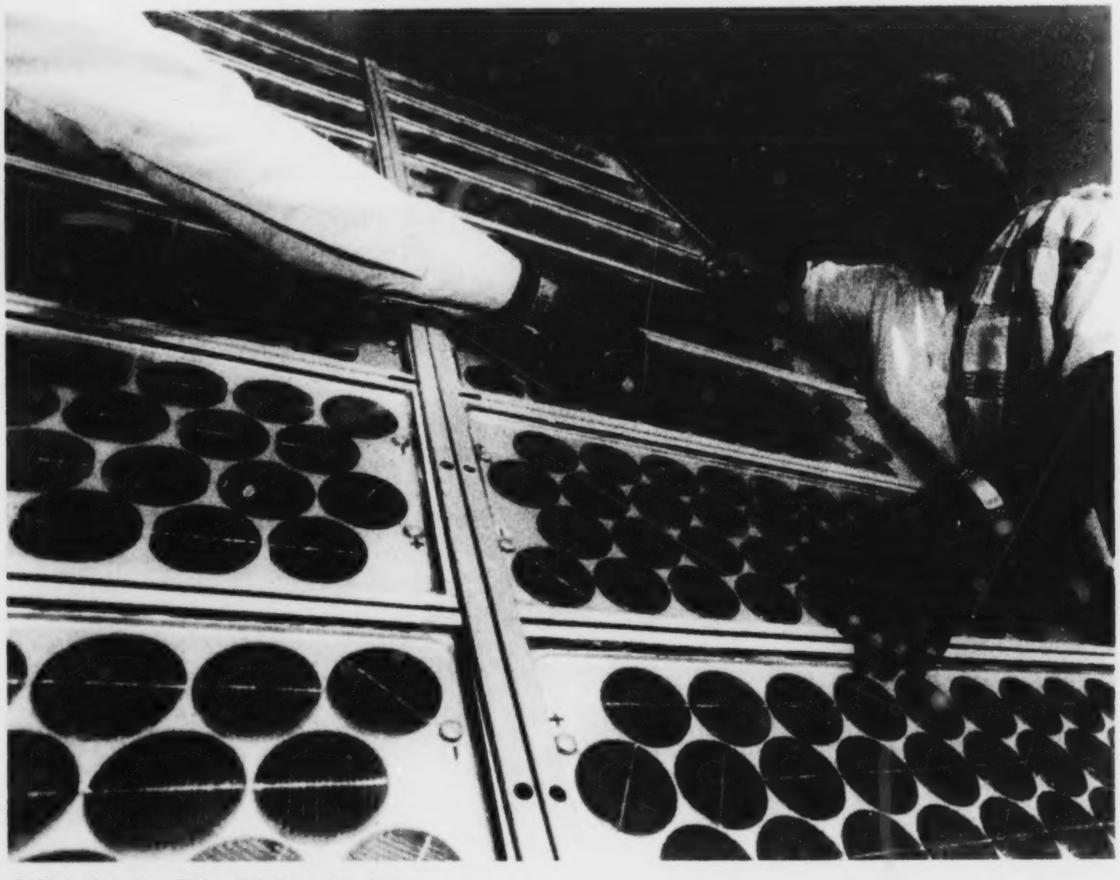

CIDA Photo: Dilip Mahta, India

BACKGROUND INFORMATION

What makes energy useful?

In order to be commercially useful, energy must be in a form that is:

1. easily convertible to the forms of energy desired by consumers, and
2. easily and economically stored or transported to the customers.

The only forms of energy currently satisfying these requirements are electrical energy and the chemical energy of fuels (eg., gasoline fuel, oil, coal, natural gas, etc.)

Energy in a chemical (oil, gas or coal), nuclear or hydro form is converted in a power plant to electricity. This electrical energy is then transported via conducting wires to our homes and factories where it is converted into other forms by electrical appliances.

Fuels are transported in chemical form by ships, trucks and pipelines. Their chemical energy is then converted to heat energy by combustion.

Of the many forms of "natural energy" available on earth only a few are readily convertible into "commercial" energy. Most important of these are:

1. fossil fuels (coal, oil, natural gas)
2. hydro-electric energy
3. nuclear energy.

Laws of Conservation of Energy

An important property of energy is its ability to change from one form to another.

Example:
The water at the top of a dam possesses potential energy. As the water droplets go over the dam and fall towards the bottom, this potential energy is transformed into kinetic energy. The kinetic energy of the falling water can be used to turn a turbine-generator which converts the kinetic energy into electrical energy. Finally, various devices in your home change the electrical energy into heat, light, sound, etc.

Teacher Activity:

To better understand the transformation of energy from one form to another, we need to know two laws of physics:

1, *First Law of Thermodynamics:*

"Energy cannot be created or destroyed. It can only be transformed from one form to another. The total energy is constant." This means that while the amount of any particular form of energy may change, the total amount of energy in our universe must always be the same. For example, if we were to measure the amount of kinetic energy possessed by water droplets near the bottom of a waterfall, we would find it to be essentially the same as the amount of potential energy the droplets had at the top of the falls.

In view of the law of conservation of energy we might wonder how there could ever be an energy shortage. The law states that when we "use" energy, we do not destroy it. We only change it to other forms. Since we always have the same total amount of energy, how can we possibly run out of it, as the term "energy Crisis" seems to imply?

The answer to this apparent contradiction lies in the fact that the process of converting energy from one form to another is much more difficult for some conversions than for others. For example, large amounts of kinetic energy exist in the motion of ocean waves, but no method has been found for converting this energy into a commercially useful form.

We can understand this better by studying another important law of physics:

2. *Second Law of Thermodynamics:*

"A natural process always takes place in such a direction as to cause an increase in the entropy (randomness) of the universe." This means that while energy is not lost, it is nonetheless downgraded in usefulness. Every time we use energy for work, or convert it from one form to another, it moves to a more random, less concentrated state where it is less available to do work.

Taken together, the two Laws of Thermodynamics state that although the quantity of energy in the Universe is constant, the quality of energy is changing into a less useful form, the random disorderly motion of molecules. The word *entropy* is used to identify this increasing disorder and universal degradation into heat. The second law really states that no conversion of energy from one form to another is 100 percent efficient; some energy is always wasted - lost irretrievably to the surroundings.

Example: Running a car on 100 units of gasoline energy will not give us 100 units of equivalent work. Most of the available energy in the gasoline is lost to the environment as heat from the friction of tires and from the engine.

AUTOMOBILE EFFICIENCY*

Process	**Losses**	**Process Efficiency**	**Cumulative System Efficiency**
Engine thermal efficiency	Heat loss from engine	29%	29%
Engine mechanical efficiency	accessory (fan, generator, etc.) Misc. heat (exhaust, radiator)	71%	21%
Rolling efficiency	heat from tires	30%	6%
Gasoline	**Efficiency**		
Production of crude oil	At well head	96%	96%
Refining of crude oil	At refinery	87%	84%
Transportation of gasoline	vehicles	97%	81%

System efficiency: 81% x 6% = 5%

*This system efficiency excludes Automobile production.

Rule: To find the efficiency of an entire energy system, multiply the efficiencies of each conversion step within a sub-system and then multiply the final products of the sub-systems.

The important point is that in the process of running our car we have not lost any energy; it has only become degraded to a less useful form - heat.

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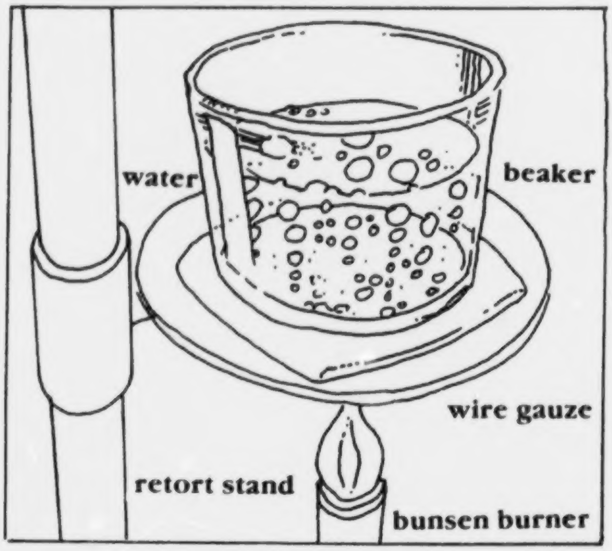
Activity 5: Laboratory Exercise

Purpose: to recognize various types of *energy transfer* and *energy transformation*.

Apparatus: bunsen burner
retort stand
wire gauze
250 ml. beaker
water

Procedure:

1. Half fill the beaker with water.
2. Place the wire gauze on the retort stand.
3. Light the bunsen burner and place it under the beaker.



Analysis:

1. Describe the energy transformation and energy transfers that take place.
2. Where does the heat energy that is produced during this experiment eventually go?

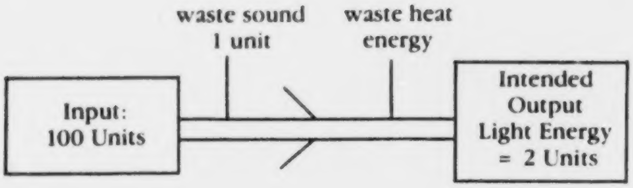
Information for the worksheet that follows:

Energy is wasted as it is converted from one form to another.

Efficiency of Energy Use

Example:

Electric Light Bulb System



Electrical Energy

Summary:

Input: 100 units Electrical Energy

Output: 2 units $\frac{2}{100} \times 100 = 2\%$ Light energy

Waste: 98 units
Total: 100 units

Student Handout **Worksheet on Energy Transfer**

		Converters of Energy	Intended to Turn Energy into Energy	Waste Energy in the form of:
Example	1	automobile	chemical to kinetic	heat, sound
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			
	15			
	16			
	17			
	18			
	19			
	20			

Answers to Worksheet on Energy Transfer

	Converters of Energy	Intended to turn Energy	Into Energy	Waste Energy in the form of:
1.	automobile	chemical	kinetic	heat, sound
2.	furnace	chemical	heat	light, sound
3.	electric fan	electrical	kinetic	heat, sound
4.	nuclear power station	nuclear	electric	heat, light, radioactivity
5.	light bulb	electrical	light	heat, sound
6.	oil-fired power station	chemical	electricity	heat, light
7.	car brakes	electrical	kinetic	heat, sound
8.	hydro-electric power	kinetic	electrical	heat, sound
9.	radio	electrical	sound	heat
10.	ski-tow	electrical	kinetic	heat, sound
11.	water pump	electrical	kinetic	heat, sound
12.	bicycle	human	kinetic	heat
13.	human body	chemical	kinetic, heat, sound	heat
14.	potato plant	light, chemical	chemical, heat	heat
15.	silicon cell	light	electricity	heat
16.	toaster	heat	chemical	heat, light
17.	TV set	electricity	light, sound	heat
18.	match	chemical	heat or light	light or heat
19.	battery	chemical	electrical	heat
20.	ship	chemical	kinetic	heat, sound

Activity 6: Energy Bank Balance Sheet

Background Information:

If we consider the earth as an energy bank, it has two types of accounts. The nonrenewable resources such as petroleum, coal and uranium can be considered to be capital accounts and renewable resources - heat and light from the sun, wind, tides, biomass, falling water, hydrogen and geothermal - can be classed as operating accounts.

Earth's capital, the nonrenewable reserves, are being rapidly devoured by our energy-hungry technologies. We have squandered our family inheritance which was formed in the earth's crust millions of years ago. If we continue to withdraw our capital without making deposits, the account will soon run out, and we will be energy bankrupt. However, in the operating account, we find earth's renewable resources in endless supply. But we have not yet learned to utilize their potential benefits. With the exception of hydro-electric power generation however, we have not yet mass-produced the technology to harness these resources at a reasonable cost.

Purpose: To enable students:

i) to understand the metaphor of earth as an energy bank and to be able to explain it verbally and visually.
ii) to understand the difference between renewable and nonrenewable resources, and to be able to give examples of each.
iii) to sense the personal responsibility of being an energy bank manager and act accordingly.

Materials: Energy Bank Balance sheet

Procedure:

1. Give each student a copy of the Energy Bank Balance Sheet with instructions that it must be completed and brought to class the following day for discussion and evaluation.

Student Handout

Energy Bank Balance Sheet

Our energy bank balance is dwindling. Because we are withdrawing fuel without replacing it, the reserves available are getting less and less. If we could use renewable resources (heat and light from the sun, winds, tides, hydrogen, biomass, falling water and geothermal heat) more often, in place of the nonrenewable resources (oil, natural gas, nuclear power and coal) our bank book would look much healthier.

Make four short lists of your main energy-use activities yesterday, under the following headings:

Home	Food	Leisure	Transportation

Now enter these in either of the two bank book columns below.

An activity like reading, a locally-grown, unprocessed food such as tomatoes or potatoes, a light powered by hydro-electricity, and a sport such as hiking use only tiny amounts of an account that is constantly being replenished by renewable resources.

Other activities which use non-renewable resources must be listed in the "Withdrawals" column, after listing the activities which use small amounts of nonrenewable energy in the "Current Account" column.

The "Current Account" column is an account that is constantly being replenished by renewable resources.

	Current Account	Withdrawals
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Question: What can you do today to improve the energy bank account?

Activity Seven: How Much Energy Do We Use?

BACKGROUND INFORMATION

This activity has been prepared to increase student awareness of energy consumption within the home.

While we claim to use 'energy efficient' appliances in our homes, we are still using a great deal of energy. One objective of this activity is to help the student become more aware of his/her family's energy consumption and be willing to bring about some changes within the household.

It is anticipated that each student will be prepared to discuss some of the following points with his/her parents at the end of the activity, which may bring about some changes within the whole family in terms of energy use within the home.

1. Is our water heater turned down to 120 degrees?
2. Are filters in the furnace clean? When was the last time they were replaced?
3. Could we replace some of our incandescent lights with compact fluorescent bulbs?
4. Are leaky windows sealed properly, especially during the winter months?
5. Do we have low-flow shower heads?
6. Do we have the proper insulation in our attic or crawl space?
7. Would it be a good idea for the family to invest in a time controlled thermostat clock?
8. Are there any inefficient appliances that we can replace? Even though the old appliance may not be broken, energy efficient appliances often save money.

If each student is encouraged to speak with his/her parents, and also to have the whole family make an effort to decrease their energy consumption, we will begin to observe the ripple effect taking place, with a reduction in energy consumption. Not only will the student be in the habit of saving energy while living at home, but good habits will develop to last a lifetime!

Sources: World Resources Institute, ***The 1993 Information Please Environmental Almanac***, Houghton Mifflin Company, 1993, p.77.

The questions above are adapted from ***Consumer Guide to Home Energy Savings***, American Council for an Energy Efficient Economy, Washington D.C./Berkeley, CA, 1991

Global Warming Home Experiments and Exercises

1. **Your family's car is a "greenhouse":** On a warm summer's day place two thermometers, one in the shade inside your family's closed car, one in the shade outside. Which reads higher temperatures and why?

2. **How is your home heated?** Wood burning stove, coal, oil electricity or natural gas? Which form of heating puts more carbon dioxide in the air? Which form of heating is the least expensive in the long run?

3. **What happens to water when it is warmed?** Completely fill a clear bottle with very cold water; add some dye or food colour so you can clearly see the level to the brim top. Carefully place this bottle in a saucepan containing 2-3cm of clear cold water (no dye) and heat very gently. What happens to the coloured water in the bottle as the temperature rises? What does this experiment suggest might occur if our oceans warm?

4. **So you're too hot in the car?** You can turn on the air conditioning or you can wind down the windows. Which action cools the car down faster, puts less CO_2 in the air and costs less?

5. **What's the best way to get to school or work?** You can walk, bike, take the bus or come by car. Which mode of transportation uses the most energy? Which costs the most? Which is the healthiest?

Alberta Program of Studies Curriculum Fit

Grade 7, Topic 2: **Structures and Design**

Grade 8, Topic 3: **Consumer Product Testing**

Grade 9, Topic 4: **Electromagnetic Systems**

Activity Eight: How Much Energy Do We Use?

Objective: To calculate how much energy we use to run the appliances in our homes.

Time: 60 minutes

Materials:
Overhead of sample residential electrical bill
Student worksheet
Paper
Pen
Calculator
Electrical bill from home. Have some students bring in a sample from a cold winter month and others bring in a sample of a hot summer month.

Procedure:

1. Review sample electrical bill (overhead transparency). Discuss calculation of amount owing (kWh x rate).
2. Explain how to complete the worksheet. Students are to check off all items which are found in their homes and to calculate the minimum and the maximum amount of energy used during one month to see if their calculations are within range of what they've been billed (teachers can obtain a copy of ***Current Living: Appliance Operating Costs*** from TransAlta Utilities which explains the kWh calculations).
3. Supervise students' work and answer any questions the students may have.
4. Ask the students to write a short report stating where the energy consumption from their home goes and what they can do at home to reduce the cost, and therefore the usage, of energy.

Questions:

1. Why is it important to reduce energy consumption?
2. Why is the electric bill higher during the winter months than it is during the summer months?
3. What are some ways businesses could reduce their monthly electrical consumption?
4. How could we reduce our electrical consumption here at the school?
5. Here is a hypothetical question: TransAlta Utilities has run into a problem and has informed their customers that during the next three weeks each household may use a maximum of 200 kWh. How would you/your family modify your lifestyle during these next three weeks in order not to surpass the kWh allotted to your home?

Extension Activities:

1. What would the impact on the amount of energy we use and the resources used to produce energy be if everyone in China had a refrigerator? Remember: the population of China is 1.2 billion!

2. What problems will be encountered in South Africa as the government of Nelson Mandela attempts to bring electricity to the poor regions of the large cities? Many people live in cardboard homes.

3. Play the *Use Your Head to Save Energy* game.

4. Try your skill on *The Spirit Challenge* Crossword Puzzle.

5. Build a solar oven. Instructions are included for an oven that uses radiant heat as its prime energy to cook a marshmallow; this oven can be constructed in a class period.

Overhead - Utilities Bill

CITY OF LETHBRIDGE, UTILITIES
910 4th Avenue South, Lethbridge, AB T1J 0P6

G.S.T. Registration No. R122211253

ACCOUNT INQUIRIES: 320-3976 8:00 A.M. to 4:30 P.M. weekdays
OVERDUE ACCOUNT INQUIRIES: 320-3999

RECEIPT PORTION

PREVIOUS BALANCE		187.02
	Total Payment(s) - Thank You NOV 04:$157.00	-157.00
	BALANCE FORWARD NOVEMBER 7, 1994	30.02

GARBAGE/RECYCLING		AMOUNT
RESIDENTIAL	Garbage Charge	7.65
	Recycling Charge	2.50
	Recycling Performance Dividend	-.29
	TOTAL GARBAGE/RECYCLING CHARGES	9.86

ELECTRIC	Component	Service	Days	Rdngs	Current	Prior	Mult	Used	Rate	AMOUNT
RESIDENTIAL	Fixed Charge	OCT04-NOV03	31							5.46
	Energy Charge	OCT04-NOV03	31	EstRdg	28315	27591	1	724kWh x	$0.0683	49.45
	Term Refund (1.01%)									-.55
	EEMA Surcharge (1.41%)									.77
	Alberta Income Tax Rebate (4.25%)									-2.34
	GST Charge (7.00%)									3.70
	TOTAL ELECTRIC CHARGES									56.49

WATER/SEWER	Component	Service	Days	Rdngs	Current	Prior	Used	Rate	AMOUNT
RESIDENTIAL	Water Consumption	OCT04-NOV03	31	Estimate	3343	3304	39CM		
	Water Fixed Charge	OCT04-NOV03	31						15.15
	Sewer Fixed Charge								4.78
	Water Consumption Charge						39CM x	$0.379	14.78
	Sewage Volume Charge						39CM x	$0.548	21.37
	TOTAL WATER/SEWER CHARGES								56.08

SUMMARY

Account Name
Service Address
Account Number
Payment Plan

Balance Forward		$	30.02
Total Garbage/Recycling	9.86		
Total Electric	56.49		
Total Water/Sewer	56.08		
Total Current Charge			122.43
Account Balance		$	152.45

Amount Paid

AUTOMATED BANK WITHDRAWAL $157.00
ON DECEMBER 2, 1994

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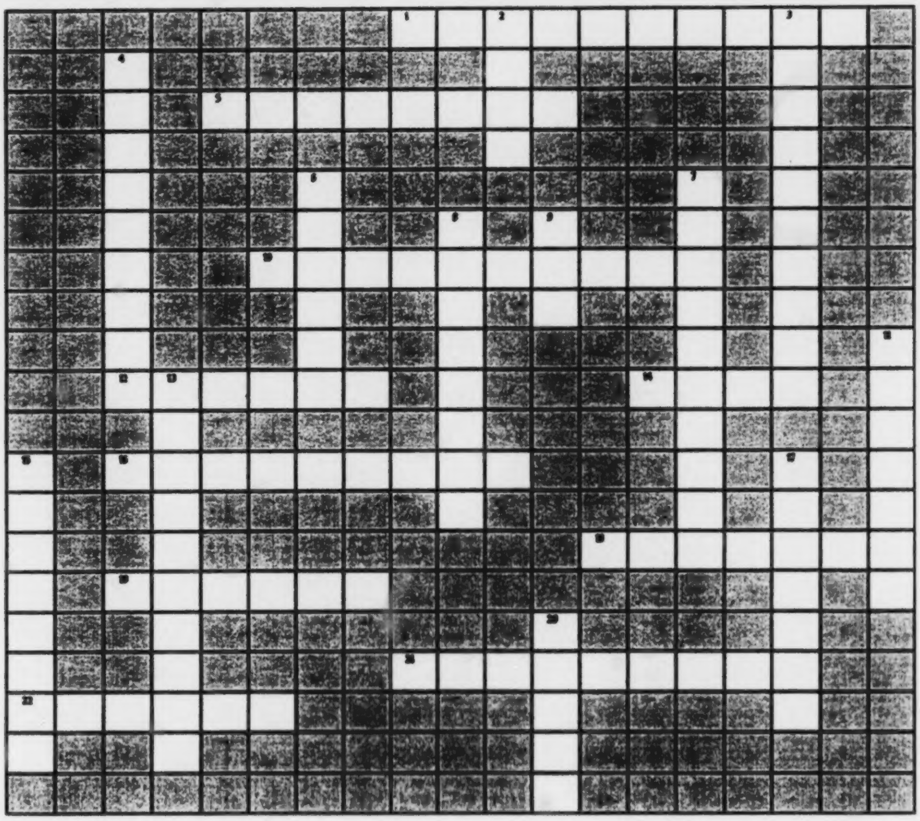
ENERGY CONSUMPTION BY HOUSEHOLD APPLIANCES

Product	Typical Energy Consumption (kWh/month) x Rate	Money spent per month
Aquarium	16.7 to 83.3 x	
Auto block heater	12.5 to 66.7 x	
Black and white t.v.	0.8 to 8.3 x	
Ceiling fan	0.8 to 12.5 x	
Clock	1.4 to 4.2 x	
Clothes washer	8.6 x	
Coffee maker	1.7 to 25 x	
Colour t.v.	6.3 to 83.3 x	
Computer	2.1 to 33.3 x	
Dishwasher	13.8 x	
Electric blanket	6.3 to 16.7 x	
Electric clothes dryer	82.4 x	
Electric mower	4 x	
Electric range/oven	54.2 x	
Freezer (frost free)	60 x	
Furnace fan	25 to 125 x	
Garbage disposer	1.7 to 4.2 x	
Humidifier	1.7 to 125 x	
Iron	1.7 to 12.5 x	
Lights (per bulb)	12 x	
Refrigerator	45 to 140 x	
Toaster	2.1 to 10 x	
VCR	0.8 to 5.8 x	
Waterbed heater	70 to 88 x	

The Energy Challenge!



ACROSS

1. It takes a lot of energy to make this so when you brush your teeth you shouldn't waste it.
5. "Turn down the ______ _______ heater to low."
10. These are made from oil. They are played on a video recorder.
12. "Turn down the volume on the _____!!!"
14. When you take a ____ you use more water than a shower.
16. This uses a lot of energy to dry your hair.
18. Machine that heats your home.
19. "Don't forget to turn off the _____when you leave the room."
21. Uses less energy than a stove because it cooks your food so quickly.
22. A plastic disc made from oil with narrow spiral grooves that reproduce sound.

DOWN

2. You put a cake in the _____ to bake it.
3. An item made from plastic that helps you clean your teeth.
4. You can save energy if you recharge these.
6. Uses electricity to keep your food cold.
7. A machine that uses a lot of water and electricity to clean your dishes.
8. An electronic machine that can store information.
9. "Don't drive the ______ to the store. Walk instead."
11. An electric gadget used to mix foods.
13. When you watch the _______ you use electricity.
15. Made from paper or plastic. These are found around most candies to keep them fresh.
17. An electric gadget that cooks a piece of bread.
20. The _______ uses a lot of energy to dry your clothes.

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Answers to "The Energy Challenge!" Crossword

ACROSS

1. Toothpaste
5. Hotwater
10. Videotapes
12. Stereo
14. Bath
16. Blowdrier
18. Furnace
19. Lights
21. Microwave
22. Record

DOWN

2. Oven
3. Toothbrush
4. Batteries
6. Fridge
7. Dishwasher
8. Computer
9. Car
11. Blender
13. Television
15. Wrappers
17. Toaster
20. Dryer

Build a Marshmallow Cooker in the Science Lab!

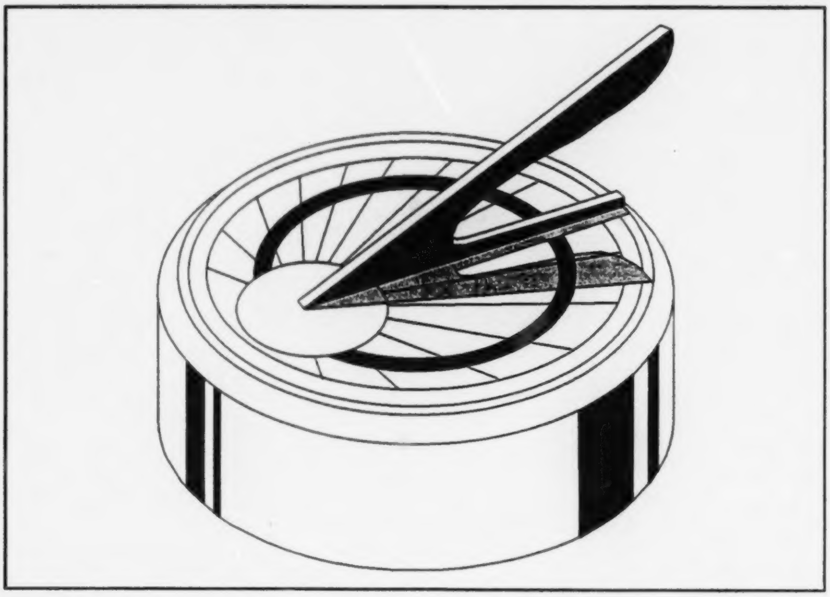
Problem: To design and construct an oven that uses radiant heat as its prime energy to cook a marshmallow in the shortest time.

Materials: 2 marshmallows, lamp, scotch tape, black construction paper, 17 cm high metal can, batting (insulation), tin foil, 8cm skewer, 8cm copper wire, mirror

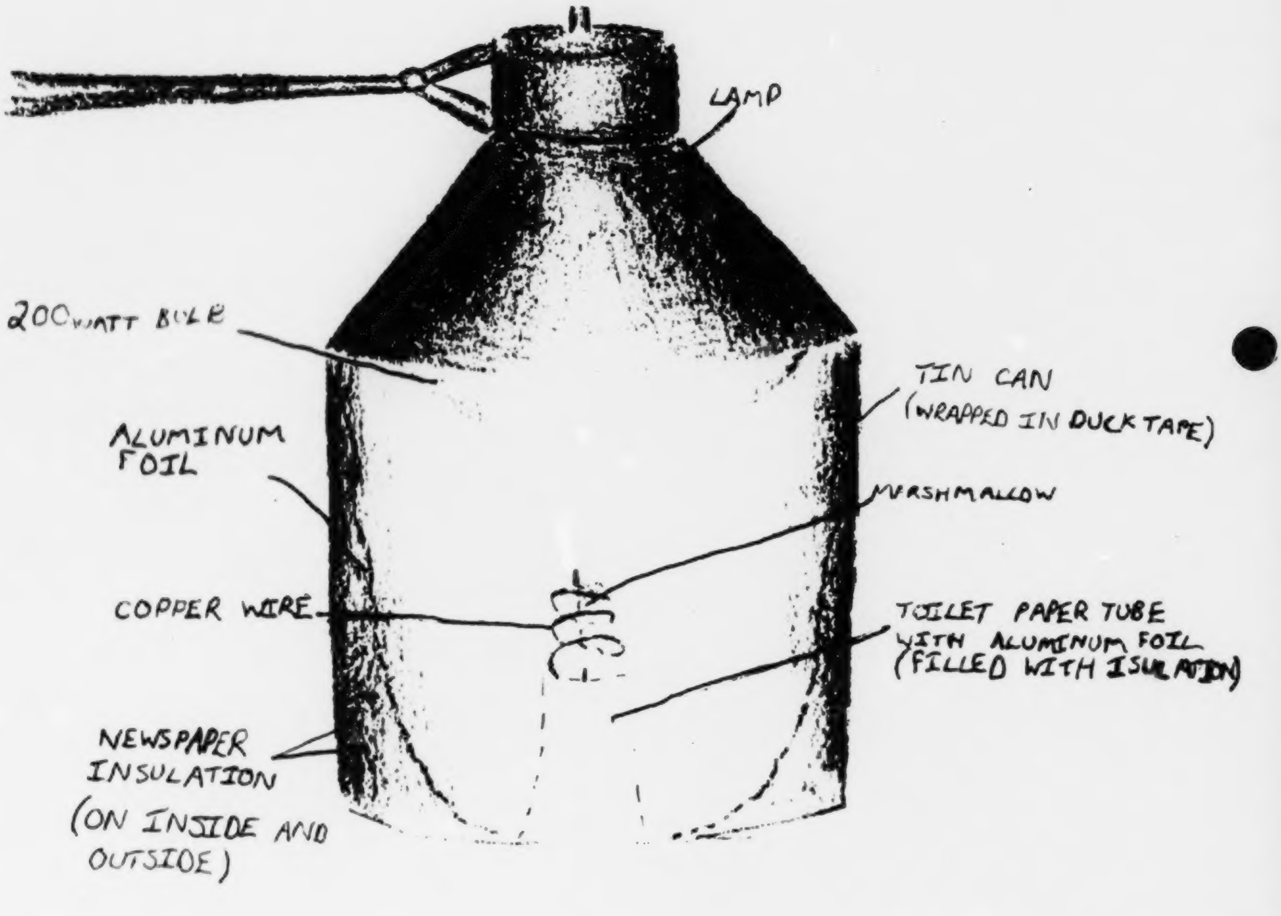
Procedure: Design and build a solar oven.

1. First, take the 17 cm high aluminum can and cover the outside with black construction paper (scotch taping it in place).
2. Fit the batting (insulation) around the inside of the can (excluding the bottom).
3. Attach aluminum foil over the batting, shiny side up, so it covers the sides of the can and protrudes about 5 cm out the top.
4. Place a mirror, right side up, at the bottom of the can.
5. Finally, take a piece of copper wire and insert it through a marshmallow.
6. Place the copper wire, with the marshmallow in place, nearly at the bottom inside of the can. Turn on the lamp and place it right over the "oven".

The marshmallow should take about 5 minutes to brown.



DIAGRAM


LAMP
200WATT BULB
TIN CAN (WRAPPED IN DUCK TAPE)
ALUMINUM FOIL
MARSHMALLOW
COPPER WIRE
TOILET PAPER TUBE WITH ALUMINUM FOIL (FILLED WITH ISULATION)
NEWSPAPER INSULATION
(ON INSIDE AND OUTSIDE)

Activity 9: Future Energy Savings

Purpose: Global Education includes looking at future possibilities, in order that we can be prepared to make necessary changes today to effect the future we want. In this activity, students identify areas in the economy where energy savings could be made. The potential costs of conservation are compared to the potential savings. Students will distinguish between monetary costs and other economic and social costs.

Materials: "Saving Energy" Chart
Futures Chart

Procedure:

1. Brainstorm with students all the ways they can think of that they might have saved energy that day. How could they save energy directly? How could they save energy indirectly? An example of a direct saving might be turning lights out; turning the heat down. An indirect saving might be recycling paper or using natural rather than synthetic fibres.

2. Why might they choose (or not choose) to conserve energy in this way?

3. Which of these choices are under our control? Which of the choices are under the control of parents or other authorities?

4. Which of these savings would be easy to make? Which difficult? Why?

5. Would people of different economic levels, or people in other parts of the world, have the same or different considerations in making these choices?

6. Distribute copies of the chart, "Saving Energy" and divide students into groups of four or five. Have students answer the questions on the sheet and then discuss the following:

   - Which of these savings could be made by changes in the way we live or lifestyle?
   - Which would take major changes in technology?
   - Which require both?

7. Distribute a copy of the futures chart to each group. On the straight line, have students in their group describe the history of natural resource use. On the line they could include the fact that cave people used few resources because there were few of them and they didn't have the technology to use resources in the same way we do. Resource use would increase with industry and with the

increase in cars, appliances and people.

After putting a few key events in the history of resource use on the straight line, ask students to indicate what they predict for the future if we continue to use resources in this way on the diagonal line moving to the bottom right corner of the futures chart. For example, what will the air be like in 15 years if every family in the world has a car or a refrigerator? What will our winters be like if natural gas reserves are depleted?

Finally, have students describe their preferred future. What would they like the future of resource use to look like? Ask each group to have at least three items on the diagonal line moving to the upper right corner of the futures chart.
In their groups, have students envision the changes people will need to make so that we live our preferred future, not our predicted future. Students should discuss what should be done at the international level, the national level, the local level and the personal level.

8. After the groups have finished their tasks, each students should write a paragraph explaining one change they will make in their own lives or in the life of their families to contribute to the preferred future. In the paragraph they should state the change and then explain clearly why this will make a difference and how they will go about effecting the change.

Student Handout

Saving Energy Facts

For each of the following examples of energy use, suggest a way that some of the energy could be saved.

1. The average single-family home loses 25% of its heat through air leaks! Eliminating air leaks is the most cost-effective way of saving heating dollars.

   How would you eliminate air leaks?

2. Just one drop per second from a leaky faucet will waste enough hot water every month for 16 baths!

   How can you help cut water wastage in your home?

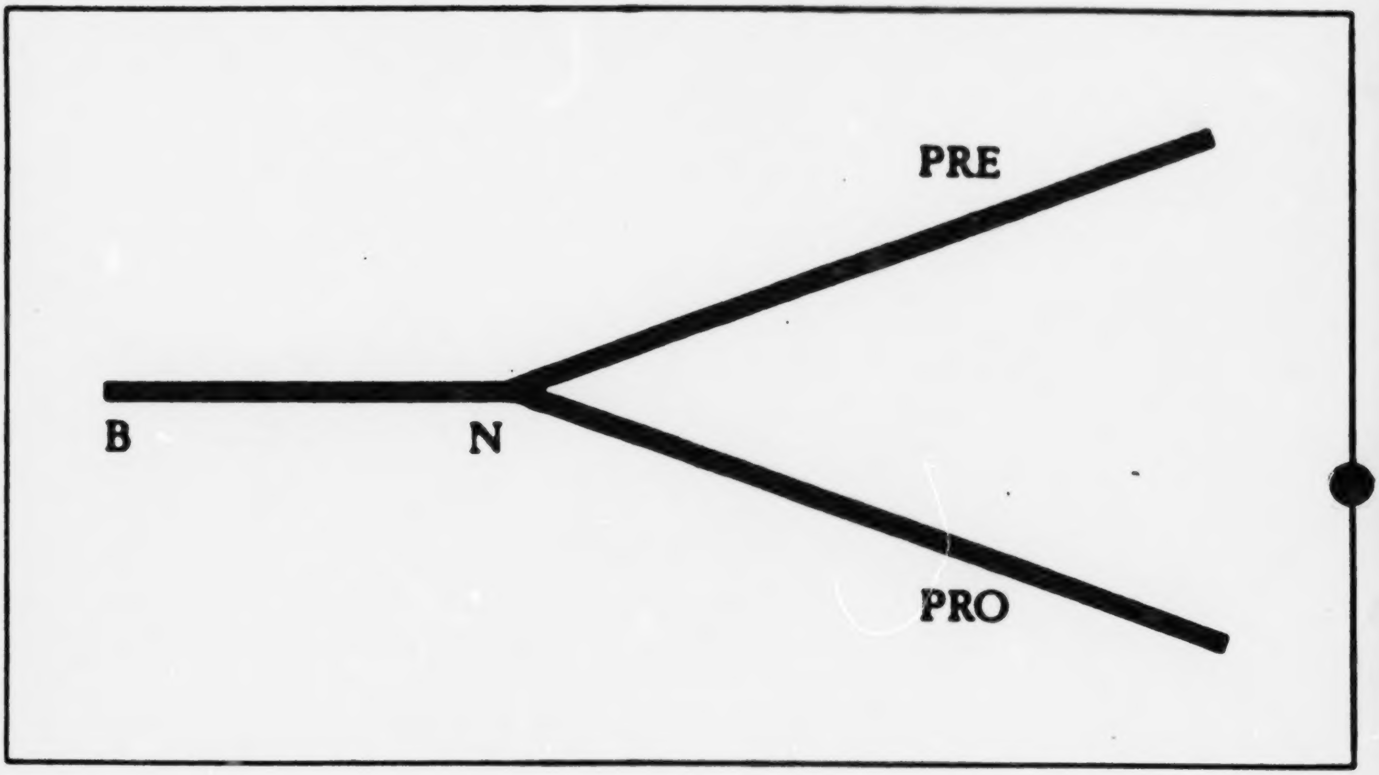
3. Reducing speed from 95 kph to 80 kph saves 10% in fuel.

   Should our speed limits be lowered? What other ways could we save gas? Are there some technological solutions?

4. At Fort Severn on Hudson Bay, a 150 kilowatt wind turbine system supplies power to 30 homes when the winds are high. This reduces the need for costly fuel for the community's diesel generator.

   Wind could supply more of Alberta's energy needs. What are some other renewable energy sources that could be more developed? What are the costs and benefits of switching to these new sources.

FUTURES TIME LINE



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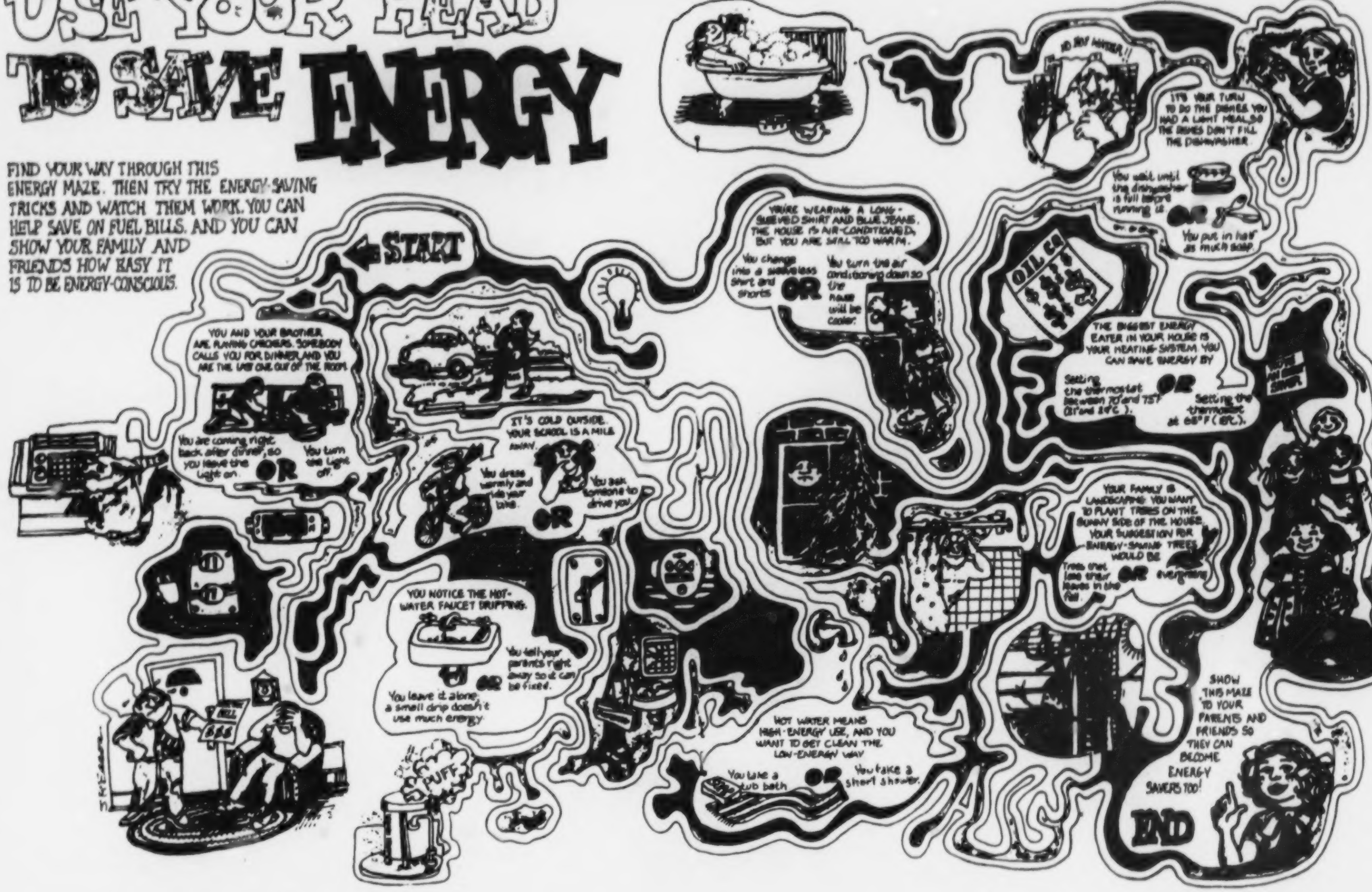
USE YOUR HEAD TO SAVE ENERGY

FIND YOUR WAY THROUGH THIS ENERGY MAZE. THEN TRY THE ENERGY-SAVING TRICKS AND WATCH THEM WORK. YOU CAN HELP SAVE ON FUEL BILLS. AND YOU CAN SHOW YOUR FAMILY AND FRIENDS HOW EASY IT IS TO BE ENERGY-CONSCIOUS.


START
YOU AND YOUR BROTHER ARE PLAYING CHECKERS. SOMEBODY CALLS YOU FOR DINNER AND YOU ARE THE LAST ONE OUT OF THE ROOM.
You are coming right back after dinner, so you leave the light on.
OR
You turn the light off.
IT'S COLD OUTSIDE. YOUR SCHOOL IS A MILE AWAY.
You dress warmly and ride your bike.
OR
You ask someone to drive you.
YOU NOTICE THE HOT-WATER FAUCET DRIPPING.
You leave it alone, a small drip doesn't use much energy.
OR
You tell your parents right away so it can be fixed.
BILL
$$$
PUFF
YOU'RE WEARING A LONG-SLEEVED SHIRT AND BLUE JEANS. THE HOUSE IS AIR-CONDITIONED, BUT YOU ARE STILL TOO WARM.
You change into a sleeveless shirt and shorts
OR
You turn the air conditioner down so the house will be cooler.
NO HOT WATER!!
IT'S YOUR TURN TO DO THE DISHES. YOU HAD A LIGHT MEAL, SO THE DISHES DON'T FILL THE DISHWASHER.
You wait until the dishwasher is full before running it
OR
You put in half as much soap.
OIL CO
THE BIGGEST ENERGY EATER IN YOUR HOUSE IS YOUR HEATING SYSTEM. YOU CAN SAVE ENERGY BY
Setting the thermostat between 70 and 75° (21° and 24°C).
OR
Setting the thermostat at 68°F (18°C).
YOUR FAMILY IS LANDSCAPING. YOU WANT TO PLANT TREES ON THE SUNNY SIDE OF THE HOUSE. YOUR SUGGESTION FOR ENERGY-SAVING TREES WOULD BE
Trees that lose their leaves in the fall
OR
evergreens
HOT WATER MEANS HIGH-ENERGY USE, AND YOU WANT TO GET CLEAN THE LOW-ENERGY WAY
You take a tub bath
OR
You take a short shower.
SHOW THIS MAZE TO YOUR PARENTS AND FRIENDS SO THEY CAN BECOME ENERGY SAVERS TOO!
END

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CIDA Photo: David Barbour, Tanzania

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Unit 4

Food Supplies

CIDA Photo: Roger Lemoyne, India

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THEME: FOOD SUPPLIES

Alberta Program of Studies Curriculum Fit

Grade levels:

Grade 7, Topic 5: **Micro-organisms and Food Supplies**

SPECIFIC LEARNER EXPECTATIONS

Attitudes

Students will be encouraged to develop:

- Awareness of the role of scientific knowledge and technologies in maintaining a healthy food supply.
- Recognition of the need for safety standards to prevent the spread of disease through food.

Skills

- Identifying issues regarding the safe handling of food.
- Identifying alternative approaches to the handling and processing of food.
- Researching
  - examining background information about alternative technologies for eliminating disease-causing organisms from food supplies
  - identifying consequences of each alternative
- Reflecting and Deciding
- Taking Action
  - demonstrating responsibility through actions

Concepts

- There is need for personal and public decision making regarding the safe handling of food.
  Students will be expected to identify practical difficulties in the management of food supplies.
- Micro-organisms are found in a variety of habitats.
- Technologies for the preservation of human food involve various approaches to the elimination of micro-organisms and to safe containment of uncontaminated food.
- *Students will be expected to* recognize that various perspectives (including scientific, economic, environmental, ethical, societal and personal) may need to be considered in decisions regarding the setting and enforcement of a standard.

Grade 9, Topic 5: **Chemical Properties and Changes**

Background Information

Oxfam Canada provides us with the following information about world hunger in their ***Hungry for Change*** *Organizer's Guide.*

Is hunger a serious problem?

The figures speak for themselves.
-In the world today, one person out of ten is suffering from the effects of hunger.
-One out of every four children is malnourished.
-Each year eleven million infants die before their first birthday. Hunger is a serious problem and will remain so unless something is done.

Is there enough food for everyone?

Yes. According to the World Commission on Environment and Development: *the world produces more food per head of population today than ever before in human history. In 1985, it produced nearly 500 kilograms per head of cereals and root crops, the primary source of food. Yet amid this abundance, more than 730 million people did not eat enough to lead fully productive lives.* There is enough food for all. The problem lies more with economics than with farming. People go hungry everywhere in the world, including North America, for the same basic reason: they don't have the resources to either buy or grow food. So to understand what causes hunger, we must understand what causes poverty.

Does drought cause hunger?

While it is true that little or no rainfall contributes to drought conditions, it is equally true that drought alone does not cause famine. After all, droughts occur with some regularity in our Prairies and yet we do not experience famines in Canada. Like in most other industrialized countries, the effects of crop failures in Canada are minimized through social assistance to farmers, by using up stored grain stocks or simply by buying food from other countries. The poor in developing countries don't have this safety net. Equally important is the fact that some of the ecological disasters which precipitate famines are created by people. Inappropriate Western high-tech agricultural techniques, deforestation, and the cultivation of the best land for export cash crops (such as coffee, cotton, sugar, bananas) have combined to create the conditions of drought. These factors also undermine a people's ancient ability to sustain themselves through cyclical weather changes and periodic drought.

Does overpopulation cause hunger?

Many people believe that hunger results from the fact that there are too many mouths to feed. But this is far too simple an explanation. For example:
-China is the most populated country in the world, and yet in 1985 the Chinese produced enough grain to send their surplus amounts to Ethiopia.
-Holland has 300 people per square kilometre and starvation there is nonexistent. In contrast, Bolivia has only 5 people per square kilometre and many of their poor die from hunger. To understand how hunger and population are related, we must ask the questions: why do the poor have such large families? In a country without state welfare, large families are a form of social security for old age. Since infant mortality tends to be high, a large family

ensures that there will be enough hands to work the land and care for the home. "Many hands" is simply a matter of survival. Overpopulation, it seems, is a symptom of hunger and poverty, and not its cause.

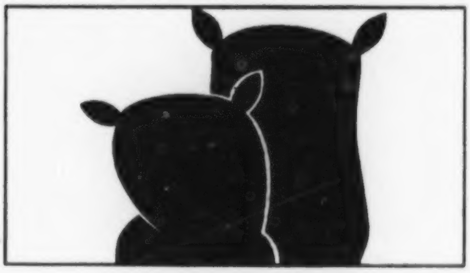
Why can't we simply send food to the hungry?

Food aid is a lifesaver in many situations, but in other cases it can do more harm than good.
-Countries receiving food aid can become increasingly dependant on it and less willing to encourage their own farmers to grow food.
-For many communities, the gift of inappropriate food drastically alters diets and can cause health problems.
-Locally grown food cannot compete with food aid and prices fall, driving local farmers out of business.
-As communities become more dependent on food aid, they become less able to feed themselves.
-As less food is produced, less work is available. Families must leave their rural communities and migrate into towns, causing slums and shantytowns to expand.
Food aid is not a long-term solution to hunger but at best a stop-gap measure. Food aid does not help the poor grow food where it is needed and it does not challenge the root causes of hunger.

Why can't the poor feed themselves by growing their own food?

In order to understand the constraints facing the subsistence farmers in agrarian and developing countries one has to ask two related questions: how is land being used, and who controls the land? Only 44% of the world's arable land is cultivated. The remainder is used in a variety of ways, including:
-grazing: in Brazil cattle ranches take up some of the most fertile land, yet 60% of Brazilians are malnourished.
-fallow: much land in Latin America is not used at all; over 80% of large estates is left uncultivated.
-export crops: during the 1970s Sahelian drought, West African countries exported 13,600 tonnes of vegetables to Europe, while 250,000 people perished in the famine.

Secondly, in many developing nations, particularly in Central America, a small minority controls most of the land. As much as 90% of cultivable land is owned by less than 20% of the population in some countries. Land to be useful must be under the control of poor subsistence farmers.



What kind of change is necessary?

Developing nations could take a major step towards ensuring food self-sufficiency for all by undertaking land reform: redistributing land from a minority to a majority of the population.

However, many of the world's poorest live in very poor countries, and a developing nation's ability to provide for its citizens is compromised by its vulnerable and inequitable position in the international economic system. For instance, much of the developing world is caught in a debt trap while at the same time aid budgets in developing countries are shrinking. Developing countries must produce more for export in order to pay the interest on their loans. In fact, because of debt service obligations, more capital flowed from the developing world to the developed world in the latter part of the 1980s than the other way around! Furthermore, since all earnings must be directed towards the debt, funding for most social programs are cut. Unfortunately, it is the very poorest in the developing countries who bear the brunt of the debt crisis.

Hunger is not their problem; it is our collective problem and the first step in solving the problem of hunger lies in our understanding just how we are connected through global systems to those who are hungry.

Background Information For the Students

One of the strongest instincts affecting all species on Earth - including human beings - is the need for nourishment. So it's no wonder that "earning one's daily bread" takes up a large part of our time or that eating can be one of the great pleasures of life. Nature worked everything out very well by inventing appetite.

However, hunger exists and it is everywhere - even in our own country. Just look at the number of shelters for the homeless and food banks. Soup kitchens cannot always feed all of the hungry who live in this, our society of abundance, where some people even die of diseases related to overeating.

In developing countries, most of the people who are hungry live and work in the countryside. And, ironically, they work as farmers. The plots of land they cultivate are often too small to produce enough food for themselves and their families. Many others who are hungry do not have the means to get land or are not paid enough for their work to make ends meet.

New arrivals to the shantytowns of large cities, such as Sao Paulo in Brazil, are often hungry people. They come from the countryside, where they can no longer scrape a living from the land. They come in search of work - which is often non-existent.

Among these people, there are those who are the most vulnerable, because they are the least socially respected: children, women, elderly persons and those who are ill.

Things in Common

People who are hungry have one thing in common: they are poor. And they will remain poor if they do not have the means to feed themselves - or worse, if the means of feeding themselves are taken away. For example, large landowners or companies obtain small plots of land, often at low prices. Put together, these parcels of land are used for large agricultural operations. But the larger operations are often less productive per hectare than the small plots cultivated using traditional farming methods.

Disease and a shorter life expectancy are two other factors that link people who are hungry. When people do not eat enough or do not vary their diet adequately, they suffer from malnutrition. Lacking calories and proteins, the body gets weaker and becomes more susceptible to diseases. People in this condition are not in any shape to work productively.

People who are poor and hungry often have more children than others do. Why? They need extra hands to do work. Having lots of children is a necessity for them. It is also a question of survival: children are often the only means of support for parents who have become too ill or too weak to provide for themselves.

Enough Food for Everyone

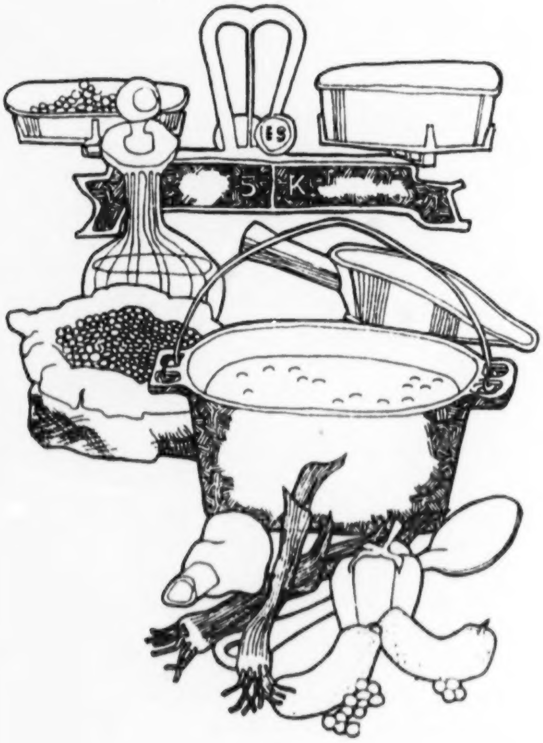
Worldwide, we produce about 1,700 million tonnes of grain a year. This is enough to provide everyone with a daily ration of 2,700 calories, while a daily intake of 2,400 calories is enough to keep a person healthy and working efficiently. Then why are there famines and millions of hungry people? Hunger is not just a question of numbers and availability of food. Hunger is a problem of distribution, the result of unequal sharing of food.

People who are hungry cannot obtain food for a variety of reasons. There are some who do not have the means: money, land, fertilizer, tools or even work.

Another reason is the fact that large landowners and powerful companies control the world food commodities market at every level: production, distribution, processing and marketing. They set the prices of commodities and often the prices of processed products. With this market system and its laws, hungry people have no real power to change even their situation.

Are There Solutions?

World hunger can be eliminated. Solutions are already being implemented, collectively and individually, but it is a huge challenge. It will take time and a lot of willingness to change. We have to take a good look at our ways of doing business. We also have to support efforts for democracy, peace and human rights. A more just society is one in which everyone has enough to eat.



If you have plenty to eat, you should not feel guilty. What is important, though, is to make an effort to inform yourself about the problem of world hunger and to try to understand the causes. You might find that to arrive at a global solution, we have to follow more often the path of cooperation, which leads to sharing. As we learn to share among individuals, we learn to share among peoples. At the root of it all, it means learning to build a future together: each person working in his or her own way to help fulfil the world's quest for food.[1]

1.This information is taken from "Quest for Food", in ***Under the Same Sun***, a publication of CIDA, 1993. It is from an article by Jean-Luc Maltais called "A Foretaste".

This and other issues of ***Under the Same Sun***, produced by CIDA for youth, can be obtained free of charge by writing to:
Youth Editions, Canadian International
Development Agency, P.O. Box 1310,
Postal Station B, Hull Quebec J8X 9Z9

Activity 1: Food Around the World
A Cooperative Activity

Purpose: The purpose of this activity is to simulate conditions of food preservation and storage in various parts of the world. Students can then see connections between these conditions and way-of-life, diet and food preferences throughout the world. They can also see how available technology, weather conditions and availability of fire affects the kind and variety of food in a particular place.

Materials: Food cards and condition cards

Procedure:

Students are divided into nine groups. Each group selects one card each from the pack of "food" cards and the pack of "conditions" cards. The group then works together to decide on

(a) what foods can be preserved, using what methods
(b) what foods can be stored, and how
(c) what foods must be eaten immediately, if at all
(d) what kind of diet the inhabitants of the region would have throughout the year

When the decisions are complete, the group will report their decisions to the whole class, and give reasons for these decisions. The group can also try to describe the environment that has these characteristics-- is there a place in the world like it?

Further Activities:

1. The teacher randomly changes one condition on each group's card. How would that affect the kind and variety of foods available? How would it affect how food is preserved and stored?

2. The teacher randomly declares a "crop disaster" or "extermination of a species" affecting each group's food resources. How would that affect the variety of foods, and preservation and storage methods?

3. Groups are given a fixed amount of time to exchange either the food cards or the condition cards with other groups (only if they want to) to improve their 'situation' . Does this make the total situation more equitable?

4. Each group makes a pinboard display to show what life would be like, given the conditions on their cards.

conditions on their cards.

5. The chart following the food and condition cards describes a typical diet of children aged 5 in three different parts of the world. Students discuss the following in groups:
   (a) Analyze the ingredients of each item on these menus. Which ingredients can be grown in the country? Which are likely imported?
   (b) Why is it important to eat a healthy, balanced diet? Which of these diets could be improved? How? (A copy of Canada's Food Guide would be useful for students to look at.)

6. Groups further investigate certain conditions or sets of conditions. Some examples:
   (a) why would fire be difficult to use?
   (b) why would conditions such as hot, humid weather affect food preservation/storage?
   (c) students search the media (newspapers, magazines, etc) for examples of food preservation/storage problems, successes, changes, etc. and contribute to an ongoing pinboard display.

CIDA Photo: Paul Chiasson, Zambia

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Food Cards

-mixed cereal grains
(wheat, rye, barley)
-wide variety of fruits
and vegetables
-wide variety of animal
flesh

-rice
-various fruits in
season
-bamboo shoots and
bean sprouts

-fish
-shellfish
-coconuts and similar
fruit

-yams and other
tubers
-berries in season

-fish
-small sea mammals

-large fur-bearing
mammals
-fruits and berries
(short season)

-maize (corn)
-fruits and vegetables

-rice
-beans
-maize (corn)

-millet
-various vegetables in
season
-peanuts

Condition Cards

-no electricity
-no refrigeration
-no canning facilities
-no technological help
-no fire

-no electricity
-no canning facilities
-no technological help
-fire available

- no electricity
-no refrigeration
-long, cold winter
-fire difficult

-limited technology:
-no electricity
-no refrigeration
but other storage/
preservation methods
are available
-fire available

-limited technology:
-no electricity
-no refrigeration
but other storage/
preservation methods
are available
-fire difficult

-limited technology:
-no electricity
-no refrigeration
but other storage/
preservation methods
are available
-no fire

-all technology is
available
-very hot, humid
weather conditions

-all technology is
available
-temperate climate

-all technology is
available except fire
-very long, cold
winters and short, hot
summers

The Question of Food

TYPICAL DIET OF CHILDREN AGED 5 IN THREE DIFFERENT PARTS OF THE WORLD

CANADA

BREAKFAST	LUNCH	DINNER
150ml orange juice 125ml corn flakes 1 slice whole wheat toast 5 grams butter 10 grams jelly 125ml 2% milk	60g tuna, cheese or ham sandwich 125ml mixed green salad with tomato 1 apple 200ml 2% milk	125ml fruit cup 60g pot roast, lean meat 125ml mashed potatoes 75ml carrot rings 125ml spinach salad 1 piece angel food cake 125ml 2% milk
Snack 1 small banana		**Snack** 4 crackers 15g peanut butter raw vegetable sticks 200ml 2% milk

Approximate analysis : 1600 kilocalories (6700 k J) 60g protein

Source : as suggested by Reader's Digest :Eat Better Live Better , 1983

AFRICA : UGANDA, BUKEDI district

Morning snack	Snack	Main meal
200g plantain	100g plantain 112g mango	300g plantain 30g ground peanuts 40g sundried termites

Approximate : 900 kilocalories (3770kJ) 27g protein

Source: Dr. M. Mackey Macdonald College McGill University

CHINESE INDONESIA

7 : 30 AM	175ml rice
10 : 00 AM	200ml wonton soup 175ml rice
noon	175ml rice with 5g oil 45g salty spicy fish 60g mushrooms, red and green peppers, snow peas, carrot tidbits .
4 : 00 PM	175ml rice 1 small banana 250ml coconut water .
6 : 00 PM	175ml rice with 5g oil 30g wonton (meat in pasta) mixed vegetables (bean sprouts, carrots, celery, tomatoes) .

Approximate analysis: 1240 kilocalories (5188kJ) 36g protein

Source: L.Bernard, Macdonald College, McGill University.

The recommended energy intake for a 5 year old child is 1600kcalories (6700kJ) on the average . The protein content should be at least 30 grams . Intakes below this result in chronic undernutrition .

BEST COPY AVAILABLE

CIDA Photo: David Barbour, thailand

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CIDA Photo: Dilip Mehta, Sri-Lanka

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Extension Activities - Food Supplies

1. **Name That Food**: Using words that relate to all five senses, describe a food to your friends, and let them guess what it is. The winner describes the next food.

2. **The Food Map:** Draw a diagram or map that shows the complete path of our food from its original source to its final form at the dinner table. Can you explain each stage of the journey? (eg., What journey does a banana make to come to your table?)

3. **Whoever Heard of Instant Breakfast?** What foods do you eat now that were not available to your parents when they were your age? When did the new foods come on the market, and what was your parents' reaction?

4. **Foods for the Future:** Describe and draw a picture of a new food that we might be eating in the year 2010. Will it be good for us? Why or why not?

5. **Global Goodies:** What would you say are Canada's national food and drink? Make a list of national foods and drinks from around the world. Discuss your choices.

6. **A Weak Week?** Record all the food you eat for one week and compare your record with Canada's Food Guide recommendations. Was it adequate? Where should you make improvements?

7. **A Vegetarian Isn't an Animal Doctor!** What is a vegetarian? Do you know any personally? Plan a sound vegetarian diet.

8. **Waste not, Want not:** In what ways do people waste food, and why? How can we remedy the situation?

9. **Scratch a Convenience Food:** Find out how to make a convenience food "from scratch", eg., cake mix, frozen pizza. Does the convenience food save time? money? Is it more nutritious?

10. **Time for Food:** Find out about your family's "food system". Who are the people responsible for growing or purchasing, storing, preparation and disposing of the food in your household? Can it be made more efficient, in terms of saving time, energy, or money? What about seasonal activities, such as Christmas?

Source: Canadian Hunger Foundation

Student Handout

Good News, Bad News

Good News	Bad News

21. Some poor people in North America have been reduced to buying pet food as a source of protein.

22. There is a booming trade in North America in vegetarian cookbooks.

23. It takes 500 billion years to build up an inch of topsoil.

24. Annual consumption of red meat and poultry combined is at an all-time high in North America.

25. Nearly 40% of the world's total grain is fed to livestock.

26. From 1965-1990, world cereal production increased over 70% and more than doubled in developing countries.

27. Without a major expansion of arable land, the world average of 0.28 hectares of cropland per capita (2,800 square meters) is expected to decline to 0.17 hectares by the year 2025 if current population projections hold true.

28. In Asia, an estimated 82% of potential cropland is already under production.

29. Cropland expansion will most likely come at the expense of rangelands, forests (including rainforest), wetland and other areas that are both economically important and ecologically fragile.

30. The number of calories available per person in 94 developing countries rose from 1940 per day in 1961-63 to 2460 per day in 1984-86.

31. Between 1970 and 1985, the estimated number of malnourished people throughout the world increased by over 50 percent.

32. About 5% of North American farmers are cutting back on chemicals and adopting alternative farming practices that are both economically and environmentally beneficial.

33. Average annual marine catch worldwide increased by 30% from 1975 to 1987.

34. In 1992, Canada declared a moratorium on the East Coast cod-fishery.

35. India more than tripled its grain harvest between 1965 and 1983. Since then, grain production has not increased.

36. By the year 2000, India is expected to have approximately one billion inhabitants.

37. Each year, the world's farmers lose an estimated 24 billion tons of topsoil from their cropland in excess of new soil formation.

38. Many widely used pesticides and herbicides are toxic. The run-off of these chemicals can contaminate ground-water and endanger wildlife.

39. Enough grain is currently grown worldwide to feed six billion people on a no-meat diet.

40. An estimated one billion people had deficient diets in 1993.

Handout for Activity 2: Good News, Bad News

1. Some countries are paying their farmers not to produce food.

2. Most nations of the world are more densely populated than Canada is.

3. Much potentially arable land must be irrigated.

4. Tropical land receives greater solar radiation, and multiple crops could be raised each year on this land.

5. The soil in many tropical areas is very poor and erodes easily.

6. Infant death rates are dropping in almost every country in the world.

7. Most nations of the world now have family planning programs.

8. Many of the new high-yield varieties of grains have lower protein content than pre-World War II varieties.

9. Research is now concentrating on developing and testing grain varieties with high protein content as well as possible additives to enrich the present varieties.

10. The population of the world is growing by 95 million people each year.

11. Life expectancy has increased in most parts of the world.

12. There are more hungry mouths in the world today than ever before in history.

13. The use of improved seed lines, water control, more fertilizer, and disease and pest controls have together brought about sharp increases in grain production around the world.

14. North America has six percent of the world's people and consumes almost 35 percent of the world's resources.

15. A map of the cultivated land on our planet shows Eastern and Central United States, Europe, the Russian plains, India, and China to be the major cropland areas; the best, by far, are those of the American Midwest.

16. Most countries, including Canada, are running out of land that can be converted to cropland.

17. Land not under cultivation will require immense inputs of money for clearing, irrigation, and fertilization to make it productive.

18. Much productive land is used for non-nutritive crops such as tobacco, coffee and cotton.

19. The food that is annually lost in India to pests, poor storage, and poor transportation could feed 50 million persons.

20. Less than five percent of the soils of the tropics are potentially fertile cropland.

Activity 2: Good News, Bad News
Where do we stand?

(From: Pamela Wasserman and Andrea Doyle, Washington: Zero Population Growth, Inc., 1991. Printed in ***A Two-Way Approach to Understanding: Issues in Global Education***, New Brunswick, 1993. Used with Permission)

Objectives: When studying global issues such as population growth and food availability, we must refer to a number of data resources to get a clear picture of the situation. In this activity, students determine whether given statements on population growth and food issues are "good news" or "bad news". They then compare data to identify relationships and shape their evaluation of population/food issues.

Procedure:

1. Have students read the background information on food provided on the first two pages of this section. Ask the students if they are pessimistic or optimistic about the chance of feeding the world and slowing rapid population growth.

2. Tell them that you would like them to rate some statements of fact. Have them decide whether the statements are, in their own judgement, "good news" or "bad news". Have students draw a line down the middle of a piece of paper and label one column "Good News" and the other column "Bad News". Such a chart is included here for photocopying. They should then copy each statement or statement number in the appropriate column.

3. Have students discuss the ratings. You might identify some statements and discover to what degree the students agreed on the rating for each statement.

4. Then discuss these questions:
    - Are there statements in one column that make another statement seem better or worse?
    - What other statements make a statement seem much better or much worse?
    - Take a statement and draw lines to the other statements on the list which affect it.
    - Does the data confirm your pessimism or optimism? Why?

5. Ask the students if they have changed their minds about the ratings. Encourage them to collect more information that will help them evaluate the prospects for positive solutions to the population/food dilemma.

Shelters -- a Semi-Co-operative Board Game

This game allows students to vicariously experience the 'trials and tribulations' of having different kinds of living accommodation, and to see the effects of both natural weather patterns and disaster situations on these housing units.

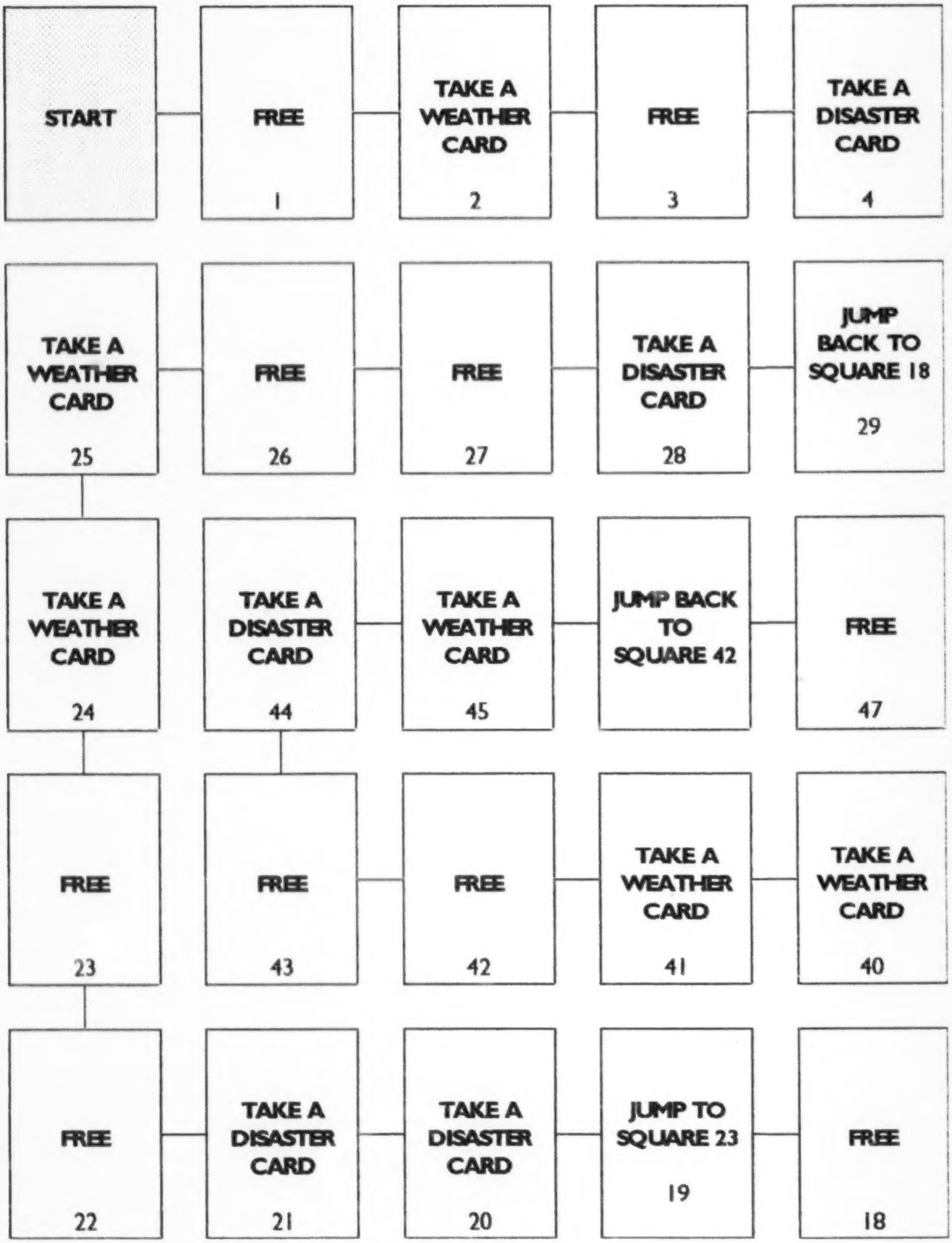
The game is played with a board (photocopy the board and either use it as is, or enlarge it and glue it to a cardboard backing for a more permanent resource), one ordinary die, some sort of board marker for each student (use coins, pebbles, or whatever), and sets each of weather cards, disaster cards, and housing cards (again, photocopy them and, if you wish, glue them to card stock for longevity).

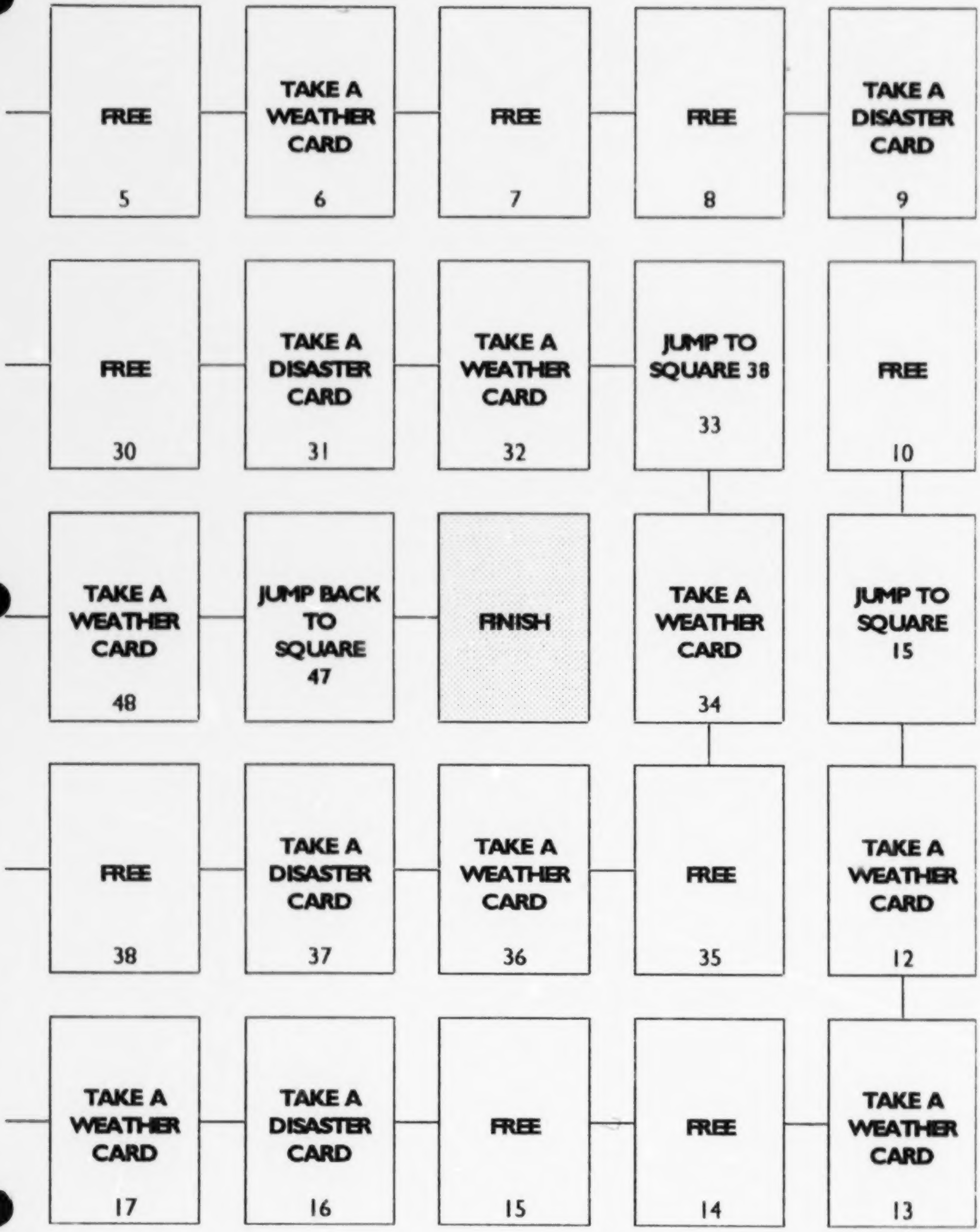
Students are divided into groups of three to five, and each group is given a set of materials. Each student in a group selects his or her own housing card and places it face up in front of him or her. Before starting the game, each group of students should discuss what each kind of housing would look like, what sort of weather would affect it in both positive and negative ways, and what sort of effect a disaster would have on it. They should realize that decisions made in the game have to be consensual, so they should have some bases of agreement beforehand.

The game starts when one student throws the die (the group can decide who should start), and moves his board marker the number of places shown on the die. He then follows the instructions on the space he lands on. If it is a FREE space, he does nothing, and the die is passed to the next student to do the same. Anyone landing on a "JUMP TO" space moves to the space indicated then passes the die to the next student. Anyone landing on a WEATHER space takes a weather card; anyone landing on a DISASTER space takes a disaster card. The group then has to decide the 'fate' of the board piece in this way-- if the group thinks the weather situation of the disaster would negatively affect the type of housing the playing student has, the board piece must move backwards the number of spaces on the card. If the housing would not be affected at all, or would even be enhanced by the card's situation, the piece moves forward. When a player has moved forward or backward in this manner, the die reverts to the next student. Play continues until one piece reaches the END space.

PRELIMINARY OR FOLLOW-UP ACTIVITIES:

(a) Class discussion of advantages and disadvantages of various types of housing
(b) Pinboard displays of various types of housing
(c) Discussion of weather patterns
(d) Discussion of natural disasters


START
FREE 1
TAKE A WEATHER CARD 2
FREE 3
TAKE A DISASTER CARD 4
TAKE A WEATHER CARD 25
FREE 26
FREE 27
TAKE A DISASTER CARD 28
JUMP BACK TO SQUARE 18 29
TAKE A WEATHER CARD 24
TAKE A DISASTER CARD 44
TAKE A WEATHER CARD 45
JUMP BACK TO SQUARE 42
FREE 47
FREE 23
FREE 43
FREE 42
TAKE A WEATHER CARD 41
TAKE A WEATHER CARD 40
FREE 22
TAKE A DISASTER CARD 21
TAKE A DISASTER CARD 20
JUMP TO SQUARE 23 19
FREE 18


FREE 5
TAKE A WEATHER CARD 6
FREE 7
FREE 8
TAKE A DISASTER CARD 9
FREE 30
TAKE A DISASTER CARD 31
TAKE A WEATHER CARD 32
JUMP TO SQUARE 38 33
FREE 10
TAKE A WEATHER CARD 48
JUMP BACK TO SQUARE 47
FINISH
TAKE A WEATHER CARD 34
JUMP TO SQUARE 15
FREE 38
TAKE A DISASTER CARD 37
TAKE A WEATHER CARD 36
FREE 35
TAKE A WEATHER CARD 12
TAKE A WEATHER CARD 17
TAKE A DISASTER CARD 16
FREE 15
FREE 14
TAKE A WEATHER CARD 13

Shelter Cards

a rondavel--mud-and-stick walls, thatched roof, dried mud floor

an igloo--carefully-cut blocks of heavy snow forming a half geodesic dome

an adobe hut--walls of brick made from sun-dried mud-and-straw, thatched roof

a tent--soft cotton walls held up by an easily-dismounted wooden frame

a stone house--fieldstone walls mortared together, a roof of wooden shingles

a wood-frame house covered with aluminum siding, a wood roof with shingles

a roof of thatched grasses, open walls of large branches laced with vines

walls and roof of unreinforced concrete

a frame of branches tied together with hemp twine, covered with broad leaves

solid fired-brick walls, wooden roof covered with fired ceramic tiles

concrete-block walls, wooden roof covered with wooden shingles

high-rise apartment building of earthquake-proof reinforced concrete

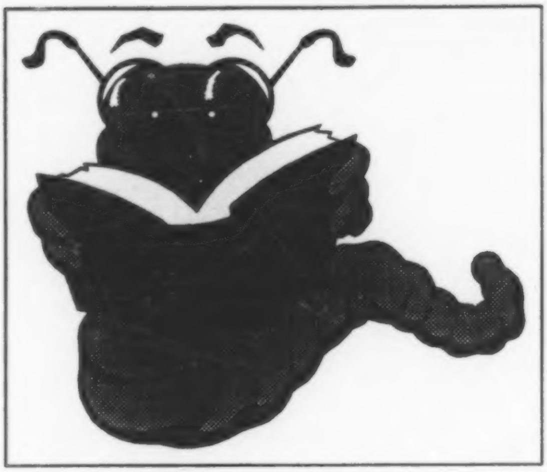
Disaster Cards

Earthquake move 3 spaces	Firestorm move 2 spaces	Hailstorm move one space	mudslide move 2 spaces
Earth Tremor move one space	Tornado move 3 spaces	Drought move 3 spaces	Flood move one space
Typhoon move 3 spaces	Blizzard move 2 spaces	Grass Fire move one space	Hurricane move 3 spaces

Weather Cards

Torrential Rains (and flooding) move 2 spaces	Extremely Hot and Dry move 3 spaces	Sudden Cold Snap --freezing temperatures and blowing snow move one space	Hurricane-force Winds move 3 spaces
Cool and Dry move 4 spaces	Heavy, Wet Snow move 2 spaces	Warm and Dry move one space	Very High, Gusty Winds move 3 spaces
Temperate move 4 spaces	Cold Snap but no Snow move 1 space	Very Heavy Rain move 2 spaces	Torrential Rains for weeks on end move 3 spaces

Resources available from the Alberta Global Education Project



Barnett House
11010 - 142 Street
Edmonton, AB
T5N 1R3
Phone: (800)232-7208
Fax: (403)453-2532

The Alberta Global Education Project
has an extensive library of teaching materials with a global education perspective. Teachers throughout the province can borrow them by calling or writing the office.

The following is a listing of just a few of the science resources that can be used to supplement this teaching package.

1. ***Acid Rain Teaching Pack***, National Society for Clean Air, 136 North Street. Brighton, East Sussex BN1 1RG. While this resource has a European focus, the role plays, fact sheets and activities can be adapted.

2. ***The Business of Agriculture: A Resource Book for Teachers of Science***, Alberta Agriculture, 1989. Designed for Science 10, 20 and 30, this book links agricultural topics such as use of pesticides, production of methane gas and genetic engineering research with the Alberta Program of Studies.

3. ***Come in Spaceship Earth: Kids as Crew Members***, Fran Schmidt and Alice Friedman, Grace Contrino Abrams Peace Fdn, Inc., 1990. This book contains visionary activities, tied to the concept of the Earth as an indivisible whole. It concludes with a simulation about life in a closed system.
   ISBN: 1-878227-06-8

4. ***Getting on the Fast Track: Aids and Drug Research***, John Zola, Social Science Education Consortium, Inc., Boulder, Colorado. Creative Role Playing exercises in Science and Technology focus on the efforts of the Food and Drug Administration to prevent and treat AIDS. Explores the social, political and economic facts that influence policy issues in science and technology.
   ISBN: 0-89994-344-6

5. ***Green Teacher Magazine***. This excellent Canadian environmental magazine is designed for and written by teachers. Subscriptions are $27/year for five issues. Make all cheques payable to Green Teacher and mail to 95 Robert Street, Toronto, ON, M5S 2N5.

6. ***Our Only Earth Series***, Zephyr Press, Tucson, Arizona, 1990. This is a series of seven non-sequential units for grades 4-12 which incorporate group work and self-directed learning. Note especially:

The Ocean Crisis	ISBN: 0-913705-50-0
The Energy Crisis	ISBN: 0-913705-66-7
Our Troubled Skies	ISBN: 0-913705-53-5

7. ***Science: The Islamic Legacy***. An Aramco World Magazine Reprint that looks at science from an Islamic perspective.

8. ***Space Age Agriculture: A Resource Book for Teachers, Division 3 Science*** Written by John Archibald for Alberta Agriculture, 1992

9. ***World Resources 1992-93: A Guide to the Global Environment***, Toward Sustainable Development, Oxford University Press, 1992. Accompanying Teachers Guide. Both are excellent resources with up to date statistics on biodiversity, energy and other science topics.
ISBN: 0-19-506231-0

Other resources for the classroom, including the magazine, ***Under the Same Sun*** - which is written for secondary school students - are available free of charge from:

Youth Editions
Canadian International Development Agency (CIDA)
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Hull, Quebec
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